Editorial

THERE isn't a great deal of apparent TV activity at the moment. Someone even suggested that the term "cold war" might be appropriate to indicate a lull between the first shots and the next manifestations of progress.

To a certain extent there is aptness in the phrase. Most TV interests are gathering their forces and facilities, training executives, hunting staff and negotiating for equipment.

Undoubtedly they are at last beginning to appreciate the task which lies before them. We do not hear so many optimistic statements about early starting dates, and confident predictions about how and when things will be done.

The general feeling in both Sydney and Melbourne is that TV stations will not be ready to commence a regular service until about November of next year.

There is always the chance that someone will steal a march, but I am inclined to share the conservative view.

This does not mean that TV sets will not be available for purchase until then.

Already the receiver manufacturers are working out ideas to cash-in on the initial market, in which demand is almost certain to exceed supply.

It's rather too difficult at this stage to estimate how many receivers will be available initially but it is certain that some manufacturers already have receivers complete and ready for sale.

These are intended to tide them over the early period, giving time to start up a production line as soon as this becomes practicable.

There seems a strong likelihood that, by the time we get started, the TV screen may have jumped from 17 to 21 inches. Popularity of the larger size overseas may make standardisation here hard to sustain. In the USA particularly, smaller screens are going out.

On the other hand, manufacturers here seem to be getting more price conscious as time goes on. Maybe the possibility of lengthy import and credit restrictions may have something to do with this. Higher deposits and shorter terms will affect the price Mr. Public can afford for a TV set, just as it does everything else.

In this connection the Government has set something like a record. It has virtually classed TV as a necessity even before we have it!

John Moyle

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RADIO TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

EDITOR
JOHN MOYLE, S.M.I.R.E. (Aust.)

TECHNICAL EDITOR
NEVILLE WILLIAMS M.I.R.E. (Aust.)

TECHNICAL STAFF
REG RAWLINGS
PHILIP WATSON
L. VARADY
MERVYN HUDDLESTON

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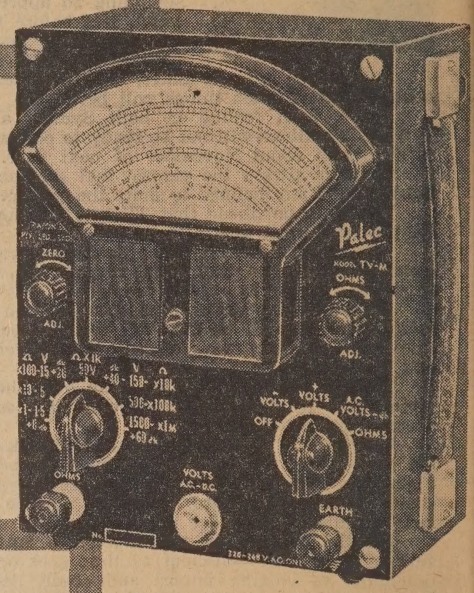

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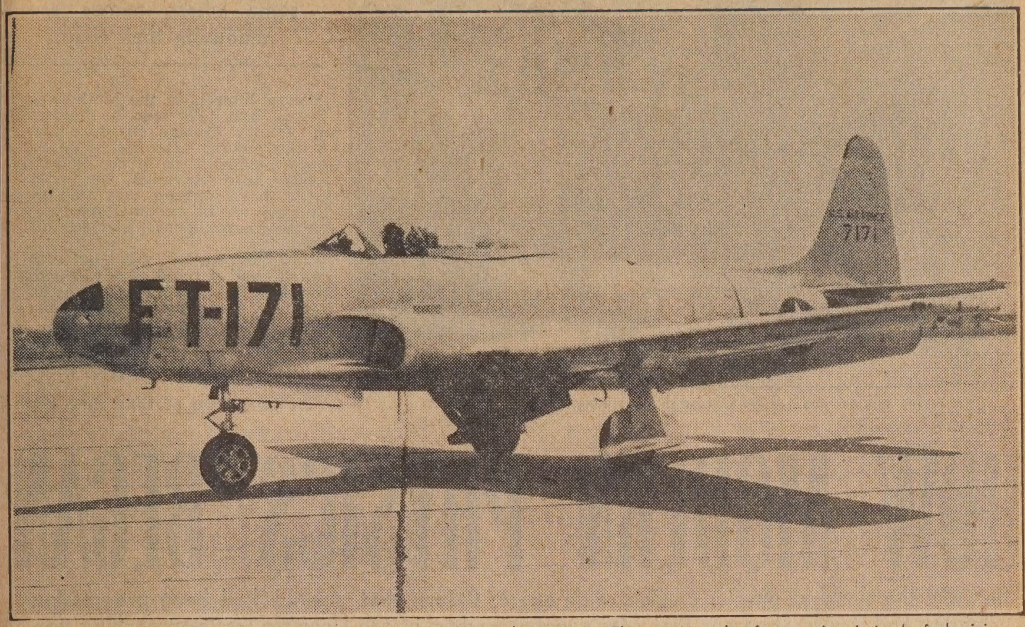
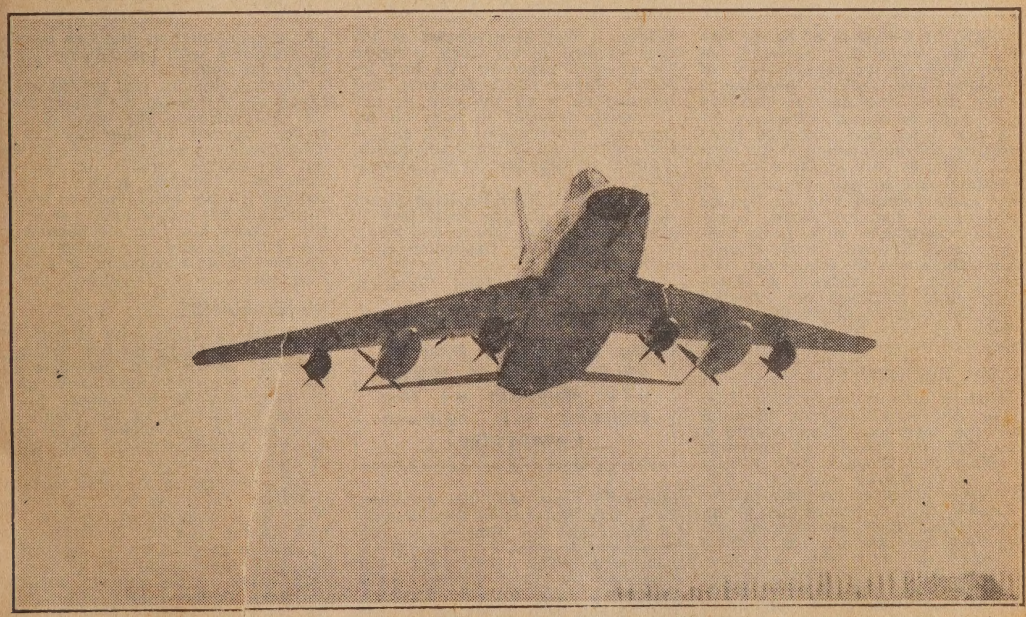
IDEAS FOR NEW FIGHTER PLANES



This looks just like any other Shooting Star single jet fighter but it isn't. This one is made of magnesium instead of aluminium. Magnesium is more rigid than aluminium although it is lighter, and fewer parts are needed in consequence. This F-80C is probably the world's first magnesium aircraft, and is faster than the regular model.



This queer looking speedster has a potent array of power plants designed to give it long range as well as a big punch when required. It is a version of the Super Sabre F-100C and can carry atom-bombs at super-sonic speeds. It is in use by the US Air Force.

The original and famous Cavendish Laboratory building, 1874.

● This is the first of a series of articles on the birth and use of Atomic Physics, written by well-known scientists including some whose names are famous in their field.

HOW MODERN PHYSICS BEGAN

In 1895 the world of physics cracked wide apart. Before that, science had been progressing steadily and it was apparent that Man's understanding of the Universe was approaching perfection. A few trifling discrepancies could be found, but most physicists felt that all that remained was to make measurements to a couple of extra places of decimals.

THEN, in the space of barely two years, came the discovery of x-rays and of the radioactivity of uranium; two striking phenomena which fitted absolutely nowhere in the scheme of things. Perhaps for the first time, such scientific news captured the imagination of the general public as well as the scientists.

Public reaction was comparable to that more recently aroused by the explosion of the first atomic bomb. As excitement was at its peak, Professor J. J. Thomson in his Cavendish laboratory at Cambridge demonstrated the existence of electrons—little particles far smaller than the smallest elemental atoms, which had been the basic building blocks of fin-de-siecle physics.

BASIC DISCOVERIES

Modern physics began with these three discoveries: x-rays, uranium and the electron. They opened a new era in the art of scientific research and brought forth a new type of laboratory scientist. The quickened pulse of the new science attracted more and more men to the laboratories; their research papers began to flood the learned journals as more and more men came advancing through the breach in our knowledge, into the open and inviting territory that lay beyond.

Nowhere was the change more obvious and intense than in the Cavendish Laboratory at Cambridge University. Only some twenty years before, it had been erected as the first building in the world designed for physical research. Its first director James Clerk Maxwell, had lavished on it all the care he had previously brought to bear on his beautiful experimental work and on his working out of the mathematical theories of heat and of electromagnetic waves.

His successor, Lord Rayleigh, owner of the finest private laboratory in the country, had given five years to developing the Cavendish as a national resource.

In 1884, Joseph John Thomson,

By Dr. D. J. PRICE, Ph.D., Curator, Whipple Museum of the History of Science Cambridge.

barely 28 years old, was appointed Cavendish Professor of Experimental Physics. At the time there were many who thought it a dubious appointment. The University had tried to get Lord Kelvin, great pioneer of the Atlantic telegraph, but he had been unwilling to leave Glasgow.

After long deliberation the choice fell on the brilliant young man from Manchester, who had distinguished himself in the Mathematical Tripos and had won a Fellowship at Trinity College for his mathematical work. He had done some experimental work in the laboratory under Lord Rayleigh, but nobody could have forseen that this theoretician would become one of the greatest experimental geniuses of all time.

J.J.—for so he was universally called—had a mind that worked incessantly with boundless enthusiasm and with a deep and accurate knowledge of the scientific literature. As an experimenter, his peculiar limitation gave him perhaps his greatest strength. He was awkward with his hands.

He had none of those fine qualities of manipulation that one usually associated with the delicate work of the laboratory.

The fact remains that he did most of his work through his experimental assistants and the band of research workers at the laboratory. Throughout his working life he threw out an endless stream of suggestions for building apparatus and sending it often unwillingly to work, correcting its errors and perversities. Under his direction apparatus was built up and torn down again and new results came in at a terrific rate.

MANY HANDS

He was a brain with dozens of pairs of hands to do his bidding, elaborate on his ideas, and then go out and work on their own with the inspiration of the master. Such is the background of the "sealing-wax and string" which was the striking feature of those early days of atomic physics.

J.J. was one of the first modern scientists to specialise narrowly. When he was appointed professor he took up the study of electrical discharges in gases—then an obscurity, but now familiar by its products; neon tubes, radio valves, cathode ray tubes for television, x-ray bulbs. He remained in this field all his life.

Fortunately it was just the place where physics boiled over in 1895. Thomson was in "on the ground

Sir John Cockcroft

Sir J. J. Thomson

Lord Rutherford

floor". Fortunately for him, too, just at that time Cambridge accepted the Research Student movement, and graduates from other universities all over the world came to work and learn at the Cavendish and other laboratories.

J.J. had an unlimited supply of fresh and vigorous pairs of hands for his work, and his laboratory became the greatest centre for the new physics.

Soon after Roentgen's discovery of x-rays, the laboratory settled down, and, interrupted only by the clamor of all local medical men for the taking of x-ray photographs of their patients' broken bones, each research worker began to inquire whether the new rays could help their own specialised investigations.

EFFECT ON GASES

J.J. tried the effect of the rays upon electrical discharges in gases and found that it was just what was needed to simplify his attack on the problem. Gases usually needed unwieldy violence (e.g. a spark) to make them conduct electricity, but under the influence of x-rays they conduct easily and normally. The little particles of gas become charged or ionised by the bombardment.

Using this phenomenon, J.J. extended a method used by his student, John Townsend (later Sir John), and was able to find the size of the charge produced. Combining this with results obtained from measuring cathode rays he was able to confirm his guess that the cathode rays were not rays at all, but streams of tiny charged particles, far smaller than atoms. He confirmed the existence of the electron.

Another of the students, C.T.R. Wilson, was concerned with the effect of x-rays on quite a different speciality. In 1894 he had spent a few weeks at an observatory on the top of Ben Nevis. The wonderful effects of light on the mists and clouds at the summit fascinated him, and he returned to the laboratory to reproduce such cloud effects artificially and find how they worked.

Wilson was able to do it by suddenly expanding moist air so that it condensed in tiny drops. If the expansion was just right the drops would form round the particles of dust present in the air—particles so small that they were little bigger than individual molecules. He was excited at the prospect of being able to count and "see" such tiny particles. Like everyone else he tried x-rays.

To his delight he found that even in quite dust-free air, the x-ray bombardment produced centres of condensation which made clouds form. This was the beginning of the work which later led Wilson to construct a special cloud chamber in which the drops of condensed cloud could be seen and photographed to record visually the paths of these rays and minute particles, invisible themselves.

For the first time atoms and rays could be seen "at work" and their effects studied in great detail. Today, the Wilson Cloud Chamber is probably the most important single piece of apparatus used generally by the atomic physicist.

ORIGINAL MODEL

It is remarkable that the first model, built by Wilson in 1911 and still preserved in the Cavendish Laboratory museum, was erected by him and used without significant alteration or replacement throughout his long and important series of investigations.

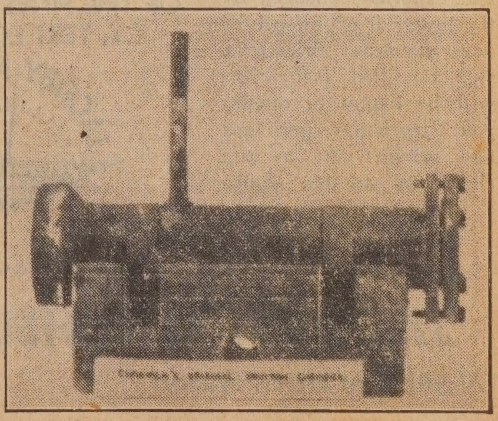
Having tackled rays of negative electrons with such great success, J.J. turned over, later, to the study of positive rays. Such rays had been known for a couple of decades, but with the great improvements in technique which had been made by about 1905, Thomson was able to produce them and make measurements impossible before.

For one thing, the old vacuum pumps were tedious to work and could not remove condensible gases from the apparatus. Now it was possible to use charcoal cooled by liquid air to remove such vapors and gases and obtain a really efficient vacuum.

SPECTRUM ANALYSIS

One success led to another. J.J. showed that the positive ray particles were individual atoms and molecules from substances in the tube, and he devised a technique for spreading out the rays into a sort of spectrum of particles of different weight and charge.

It was the dream of the analytical chemist come true. You just put the substance into the bulb, worked the apparatus and out came a record from which you could tell what sort of atoms and molecules there were present. In fact, the new positive ray apparatus did more than chemistry ever could; it showed that for some elements there existed



The original chamber with which Chadwick confirmed the existence of the neutron.

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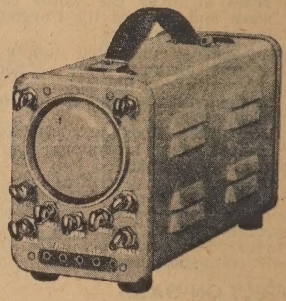

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two or more forms, identical chemically but of different weight.

For example, neon, whose chemical "weight" is 20.183, was found to be a mixture containing two varieties weighing 20 and 22 respectively. The recognition and disentangling of these different varieties of isotopes did much to help the formulation of new ideas on the structure of the atoms of elements.

It introduced regularity and whole numbers where discrepancy and apparently capricious values had been before. The work on isotopes was later developed to great heights by F. W. Ashton, who built his first Mass Spectroscope in the laboratory in 1919 and designed improved models in 1925 and again in 1937; it has now become a standard apparatus for industrial purposes.

ERNEST RUTHERFORD

The greatest of all J.J.'s band of research students was a young man who came from New Zealand to the Cavendish Laboratory in the crucial year, 1895. He was the first of the graduate students from other universities to be admitted to the laboratory.

So as not to waste time, young Ernest Rutherford brought his research with him and set about it immediately on arrival. He had made a new type of detector for radio waves, a magnetic apparatus that could receive signals over what was then a record distance of 1½ miles. Lord Kelvin advised him it was not worth taking out a patent, since there was no great financial future in radio—Kelvin's telegraph was very efficient!

Perhaps it was this discouragement, more probably it was the universal excitement over x-rays and the stimulus provided by the laboratory; by 1896 Rutherford was working with the new rays. He had entered the field of atomic physics which was to be his life work.

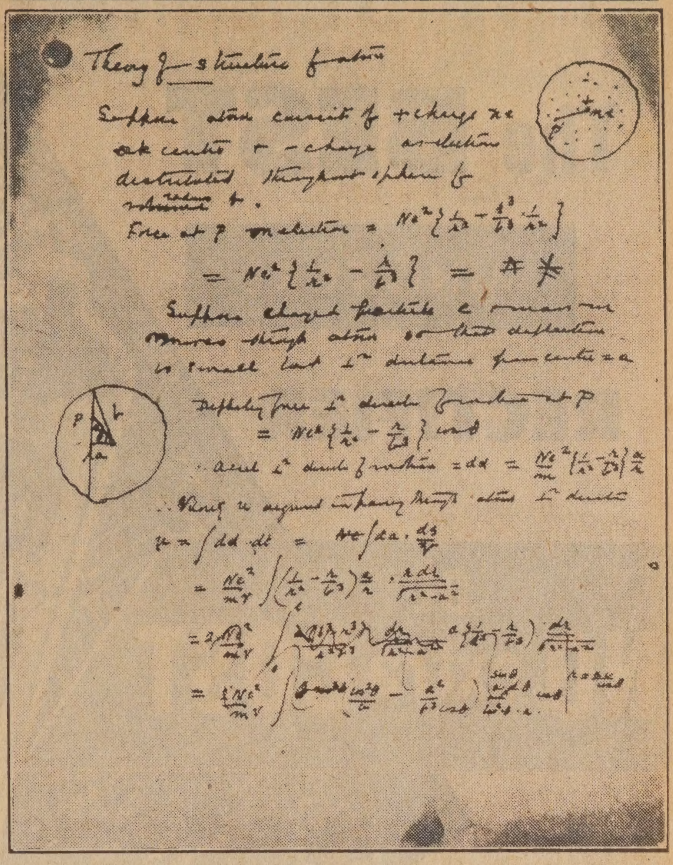
Soon he was off on his own track, trying to find out if the rays from uranium recently reported by Becqueral would give effects similar to those produced by x-rays. He quickly noticed that there were two types of ray from uranium and he called them by the first letters of the Greek alphabet, alpha and beta rays.

This was an exciting time for Rutherford. His private life was also exciting just then for he was successful in applying for the Professorship of Physics at McGill University, Montreal, and at last, in spite of the financial disappointment of the radio detector, he could afford to bring his fiancee over from New Zealand and marry her in Canada.

EXCITING TIME

Taking up the strings of his research again, Rutherford rode the crest of a wave. The isolation of radium by Pierre and Madame Curie had excited everybody, and Rutherford had triumph after triumph in his ingenious and powerful experiments. He hunted down all the successive members in the many families of substances which undergo radioactive decay; changing from one element to another at each stage and emitting rays of various sorts in the process.

WHERE SO MUCH OF IT BEGAN



Lord Rutherford's first rough notes on the nuclear atom.

He investigated the rays themselves and found that the alpha rays consisted of charged atoms of helium. He was already the acknowledged leader in this field of research.

In 1907 Rutherford returned to Europe to hold the Chair of Physics at Manchester University. His work continued, and gradually the facts of radioactivity began to fit into a scheme.

His colleague at Manchester, Geiger, had been studying the way in which such particles could pass through solid matter. The atom must consist of a small solid core, surrounded by a lot of empty space, and the nature of the scattering gave Rutherford the clue as to how the solid core was constituted.

In 1911 he announced his theory of the nuclear atom consisting of a positively charged core surrounded by a sphere of electrification; the theoretical consequences agreed completely with the measurements of scattering. This model was quickly elaborated and adapted into the picture that is still in use today.

The Dane, Niels Bohr, was the first to see that the inherent contradictions of Rutherford's static model could be saved by applying the new quantum theory, which had just been developed to account for the distribution of light given off by hot bodies. The whole new theoretical approach to atomic physics was off to a flying start.

The first world war broke up Rutherford's team of research workers and more pressing needs deflected his attention from the purely academic atomic research. In 1919 he was able to publish another epoch-making investigation. He had continued his work with alpha particles and, while bombarding nitrogen gas, he noticed a curious effect.

ANOTHER DISCOVERY

Careful checking revealed that the alpha particles must have broken up the normally stable nitrogen and made it split just like a radioactive substance. With a pocket-sized, simple piece of apparatus he had been the first man to "split the atom" artificially.

In the same year he returned to the Cavendish Laboratory as its

(Continued on Page 15)

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NOVEL PLANE SOARS AND FLIES

Shown in flight, the convertiplane combines the features of a helicopter and a normal airplane.

The McDonnell XV-I convertiplane recently performed for the first time in history full conversion in flight from helicopter to conventional forward flight and then back again to helicopter flight to make its landing. The plane has a rotor overhead, a pusher propeller, and stubby wings. It is being developed for the US Army

THE aircraft uses the overhead rotor, like that of a conventional helicopter, to take off vertically. Upon gaining a safe height above the ground, the pilot shifts the power from the rotor to the pusher-type propeller behind the cabin, or pilot's compartment.

Thereupon, the machine moves forward as an airplane. Its overhead rotor is kept spinning at a speed to provide a little lift and the least drag.

To land, the pilot reverses the process, transferring power from the pusher propeller to the rotor and then, when forward speed has diminished, settles to earth like a helicopter.

The XV-1 is designed to carry three passengers, or two litter patients, and a medical attendant, in addition to the pilot. It is 30 feet (nine meters) long, 10 feet (three meters) high, and 26 feet (7.8 meters) wide. Since it is mounted on skid-type landing gear, it is unable to land as a conventional plane.

Military experts view this type of plane as having potentials for many important military tasks, although there is a long way to go before it is perfected. They point out the plane embodies all the versatility of the helicopter—the ability to perform reconnaissance, liaison, search and rescue and troop carrying and cargo-carrying operations—but it will be able to carry out missions at much greater speeds and in longer range than the helicopter.

The exact performance capabilities of the XV-1 are secret, but its speed is much greater than that of the helicopters of comparable size. Helicopters are limited in speed because of their dependence solely on the overhead rotor.

Convertible enthusiasts see a great commercial future for the craft in the medium-range field. Unlike vertical take-off planes, it rises with the cabin in level position. It has the safety advantage of being able to pull up short if it runs into trouble and to come down vertically in the nearest clearing. However, its commercial future is viewed as being some years away.

Several countries are developing convertiplanes, but this is the first to prove in actual flight that the convertiplane works.

SUPERSONIC SPEED RESEARCH

THE worlds fastest, highest-flying airplane, the rocket-powered Bell X-1A, is currently being used for research on the heat barrier. The Bell X-1A has been flown by a pilot to a world's record seed of 1650 statue miles (2654 kilometres) an hour and to a world's record altitude of more than 90,000 feet.

A sister plane, the Bell X-1E, is under modification for an extremely thin wing and for large tanks for its rocket fuel. It too will be used for the study of aerodynamic heating at supersonic speeds.

A third Bell experimental plane, the X-1B, is at Langley Field, Virginia, having structural temperature gauges installed throughout to check heating in great detail at every point of air friction.

Meanwhile, a Douglas rocket-powered Skyrocket plane is being used to explore means of carrying bombs or fuel tanks beneath the wings at supersonic speeds. The Douglas Skyrocket has been flown 1,327 statue miles (2135 kilometres) an hour and has reached an altitude of 83,235 feet (25,370 metres).

Still another experimental aircraft, the stiletto-like Douglas X-3, is testing the puzzling behavior of air in the transonic range — the extreme buffeting that occurs in the speeds ranging from 600 to 800 statute miles (960 to 1,280 kilometres) an hour. This plane, whose performance is secret, is longer and heavier than the Douglas DC-3 transport plane, yet it flies on wings smaller than a DC-3's tail.

"THE LANDING OF CAPTAIN COOK" by Philip Fox. By Courtesy of the NATIONAL GALLERY OF VICTORIA.

"Captain Cook Discovers New Continent"

RADIO AUSTRALIA flashes daily news around the world. Jocelyn Terry is shown here broadcasting messages from home to Australians in lonely outposts in Antarctica.

This was stirring news to the world of 1770, but it was three months before King George III of England heard about it.

Today, news like this would be flashed round the world by radio.

In Australia from Cape York to Hobart, from Brisbane to Perth, radio listeners hear immediately about any important national event.

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The SHELL Company employs 5,000 research scientists. Some of the work they have done for radio has improved various parts of electrical equipment such as enamelled wires, insulating materials and resins which effectively seal radio condensers.

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Shell shares in the advancement of radio technical equipment for the benefit of listeners.

REACTOR FOR MEDICAL RESEARCH

The first atomic energy reactor specifically designed for medical treatment and research will be built for the University of California at Los Angeles Medical Centre by North American Aviation's Nuclear Engineering and Manufacturing Division, it was announced recently in the USA.

THE new reactor will produce gamma rays and neutrons for cancer therapy, and also has been designed to serve a variety of additional medical and non-medical uses. These include the production of radioisotopes, and radiation for experimental sterilisation and preservation of food and drugs by nuclear energy.

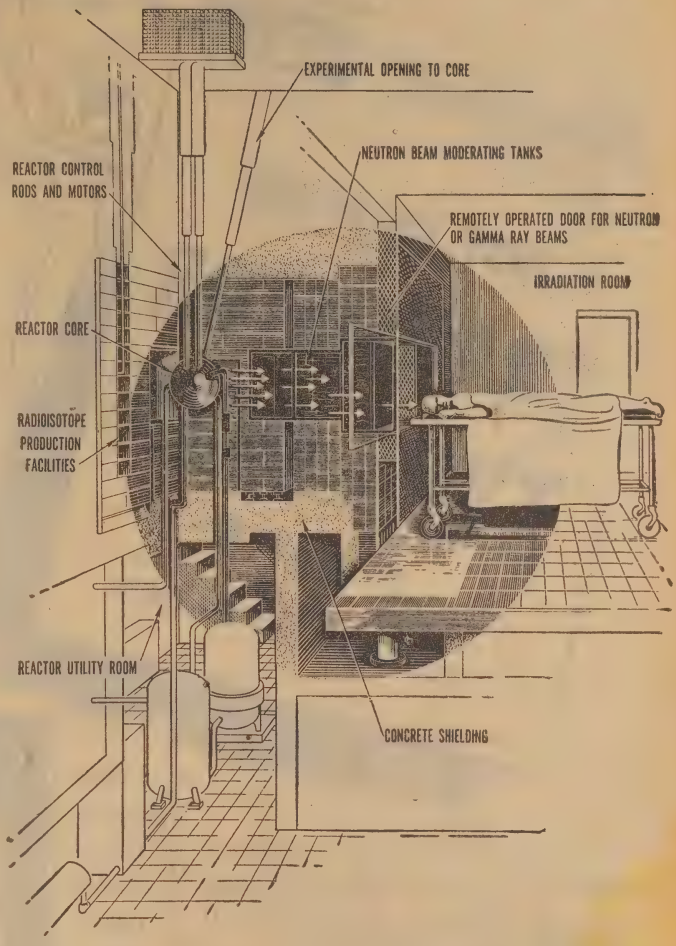
The reactor, which is expected to be completed within one year, also will be available for use by the Atomic Energy Commission in conjunction with the Atomic Energy Project at UCLA, where both classified and unclassified research in biology and medicine is carried on.

WORKING MODEL

A working model of the reactor was demonstrated at a conference on the UCLA campus near the site where the actual machine will be installed in a new underground wing of the University's Medical Centre.

Designed to operate at a power level of 5 kilowatts, with a maximum power of 50 kilowatts, the medical reactor will produce a high intensity of neutrons, subatomic particles available only from a nuclear reactor in the large amounts required for medical therapy and other atomic research. Gamma rays produced by the reactor will be of greater intensity than those produced by 50 pounds of radium.

The reactor's atomic fuel is to be obtained on loan from the AEC, and will consist of about four gallons of uranyl sulphate solution, highly enriched in Uranium 235, contained in a one foot stainless steel sphere, or core.



Artist's sketch of the reactor. It will also be used to produce radioistopes and radiations for studies in the preservation and sterilisation of food. This picture shows the reactor proper.

CORE SHIELDING

It is the "splitting up" or fissioning of the Uranium 235 atoms in the solution which provides the gamma rays and neutrons for medical treatment and other nuclear research. The core will be located inside a 5 x 5 x 8 foot stack of graphite bars, shielded by five feet of high density concrete. Radiation ports will lead from the core to a patient treatment room, laboratory, and another room where research on animals can be performed. An access port will permit materials to be irradiated in a channel leading inside the core itself where radiation will be the strongest.

The underground reactor wing housing the complete installation will be about 45 feet wide, 60 feet long, and 27 feet high.

Rate of fission will be adjusted by control rods made of boron, which can be moved in and out of the core areas. Boron absorbs neutrons, thus when the rods are near the core neutrons are "soaked up". As the Uranium 235 atoms are split when hit by neutrons, fission will stop when the neutrons are caught by the boron rods.

The solution type reactor will be self-contained, with no radioactive particles, fumes or smoke being exhausted into the atmosphere or public disposal systems.

Either gamma rays or neutrons can be obtained from the reactor for cancer treatment. While both are radiated from the reactor during the fission process, gamma rays or neutrons can be selected by use of special shielding equipment between the patient's room and the reactor core. The size of the radiation port can also be varied to provide radiation in the required amounts of intensities.

DEEPER PENETRATION

Gamma rays destroy cancer cells much in the same way as is done by x-rays, but the gamma rays penetrate deeper through tissue, and are much stronger than x-rays.

Irradiation of cancer cells with neutrons is often accomplished by the "boron capture" technique. This requires the injection into a tumor

f a solution containing the element oron. Due to the particular nature f the cancer cell, the cancerous tisue absorbs the boron much more uickly and in greater amounts than oes healthy tissue. When the canr area is bombarded by a stream f neutrons, the boron atoms in the ancer cells release "alpha particles". hese particles, which are tiny asses carrying an electrical charge, nd weigh about four times as much s a neutron, are effective cancer ell killers. Alpha particles have a hort penetration range, primarily onfining their destruction to canr cells and doing relatively little arm to healthy tissue.

RADIOISOTOPES

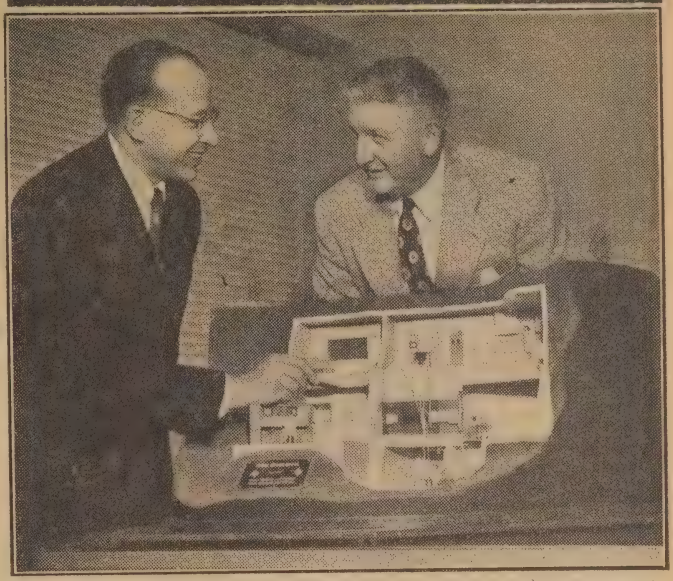
As a local source of radioisotopes he new reactor could make a naterial contribution to the expandng technology in this rapidly growng field. Radioisotopes, particles nade radioactive by neutron exposure from the reactor, can be "salted" into almost any material oncerned with the fields of medine, agriculture, or industry. By radioactive detection devices, these adioisotopes can be followed or raced to reveal what goes on inside human systems, plants, processes, and machinery.

Although radioisotopes are available from reactors located in various parts of the country, the strength of the radioactivity of these materials is often dissipated by the time they have travelled long distances to the point where they are needed. The UCLA reactor could provide these materials at near full strength for requirements in this area.

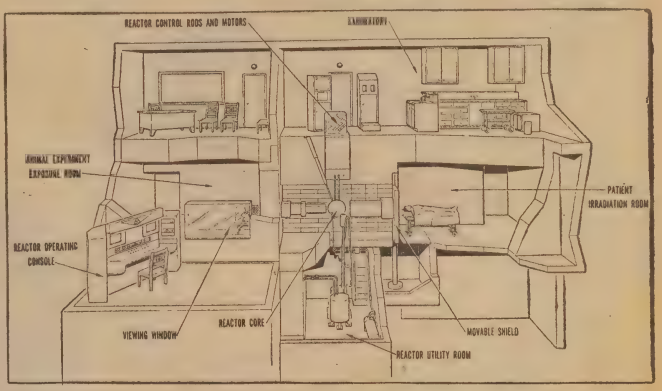
The experimental use of radiation from nuclear reactors to preserve and sterilise foods and drugs is a promising field which is expected to lead to revolutionary processing methods. Research in this field has already demonstrated the possibility of increasing the "fresh" life of meat, vegetables, and dairy products by atomic radiation.

Use of radiation sterilisation in the pharmaceutical field also offers a number of benefits. For example, sterilisation processing requiring high temperatures which often reduce the strength and effectiveness of drugs might be replaced by radiation processing at room temperature. Nuclear researchers at UCLA have scheduled times with the reactor for this type of developmental work in addition to their other studies.

MODEL OF THE MEDICAL REACTOR



Dr. Chauncey Starr, left, and Dr. Stafford L. Warren, Dean of the UCLA Medical School, discuss model of the 50 kilowatt reactor. Scheduled for completion in about one year the reactor will be used for other nuclear studies in addition to medical research.



This sketch shows the general layout of the reactor. Compare with picture on page 11.

ARMY WANTS "FLYING MATTRESS"

BRITAIN'S M.L. Aviation Company state that they are constructing several development prototypes of the light utility aircraft which, when first announced in August, achieved international recognition as the "flying mattress".

The subject of a Ministry of Supply contract, this aircraft was designed as a simple, cheap, light aeroplane for use with the Services, particularly the army. In order to provide adequate wing area and structural strength and, at the same time, keep down the total weight, an air-inflated wing of delta shape was specified. Aerodynamic contour is maintained by internal, spanwise diaphragms which join the upper and lower surfaces so that the external shape, when inflated, is similar to that of a conventional aerofoil.

This wing, which is made of high quality, dinghy-type fabric, is cheap to produce and light—it weighs about 100lb. When not in use, it can be rolled up into a relatively small container. It is inflated by means of a mechanical pump or bellows and, in the air, a windmill pump maintains the required pressure of under 1lb per sq. in. Inflated elevons—controls that can be used together as elevators or differentially as ailerons—are fitted to the trailing edge of the wing.

The wing is attached to the fuselage—which, on the first prototype, was a wooden carriage providing positions for pilot, passenger, engine and fuel—by vertical struts. Control is exercised by means of a hanging control column connected by cord or cable to the pneumatic control surfaces.

The first prototype was fitted with a constant-speed American 65 hp engine intended for pilotless aircraft. Obviously, more suitable power plants will have to be fitted to later models, and the M.L. Company plan to adopt a British engine for production versions. The aircraft weighs 550lb and can carry a load of some 400lb. Take-off and maximum speeds are 18 m.p.h. and 45 m.p.h. respectively.

SCIENCE NOTES BY PROF. A. M. LOW

By now we are quite used to the idea of flight into the stratosphere by man but not, I think, by insects. Our impressions are due for an overhaul, I'm afraid.

A FEW years ago a small "Scientific Army" explored the upper air in order to find out how certain insects, fatal to the well-being of man, spread out all over the world.

The aircraft used were equipped with special insect-catching traps.

Spiders were found three miles above the earth and mosquitoes as high as 5000ft!

That menace to the world's cotton crops, the pink bell-worm moth, was caught more than a mile above our earth and numbers of ants, sand-flies, lady-bird beetles and various small insects were found in the traps at a height of 15000ft.

WIND CURRENT

It was obvious to experts that these "travellers" took advantage of favorable wind currents. They do not like rough and variable winds and will not set out on a sky trip when there is a calm. But with the winds as they want them, insects use these aerial routes to distribute themselves around the world.

On investigation it was also discovered that there are actually insect "tramps" which crawl on to the backs of other insects and squat there, travelling in perfect comfort.

It is strange that, while man is so proud of his flights into the "stratosphere", he forgets that insects have been using this route for centuries!

But enough of that.

It is strange that we still specify the testing machinery by distance. "Drive slowly for the first 500 miles," we say.

Then again, after a general overhaul we are often told not to exceed, say, 35 miles per hour.

Although it is not a good thing to produce a high cylinder temperature by a wide open throttle, the main reason is not one of explosion pushing the piston too hard but of the terrific forces, amounting to many tons, exercised in the engine by the reversal of reciprocating parts.

TIME AND DISTANCE

Time and distance, if not the same thing, are closely connected and, in the aircraft world, we mix distance and time almost indiscriminately. The fact is the faster we travel, the more time matters instead of distance.

I was at an exhibition of flying models recently and saw an improved type of skimmer, part aeroplane and part high-speed seacraft.

Think for a moment of the problems of science in connection with boats, waves and ocean-going liners. Our present ideas of ship design are very conservative.

This is my point. On a small outboard boat, when air is passing gaily under the hull, slight ripples in the water do not matter terribly. But, if the boat were a model 1ft long the least ripple would swing it.

Supposing it were a quarter-mile long, would it not by the same argument skim over quite large waves simply because it covered sufficient of them to produce what we call smoothness?

If so, it suggests the possibility of fast skimming ships for carrying freight across the Atlantic, leaving it to aircraft to take expensive passengers, at least before the days when space ships ultimately take the air.

Or rather, not the air, for these 5000 mph vessels which we shall undoubtedly have in the far future could not possibly travel where our atmosphere exists.

Rockets work far better in a vacuum.

SELF DECEPTION

One has to be very careful to avoid self deception. When a car is running forward on the level with throttle closed preparatory to braking, it often seems to leap forward when it is put into neutral.

This forward leap on level ground is simply an illusion. The reason is that deceleration is decreased because, unless power is given to the car, it cannot jump forward.

The retarding effect of an engine acting as a brake is very considerable, for mechanical efficiency is never high. Disconnect the engine and the rate of deceleration is greatly reduced.

Doubtless, you will have witnessed the trick of lifting the heavy man. He is sat in a chair and four people put their hands under him in various places, then find that they cannot move him an inch.

The person who is carrying out the trick instructs two of the audience to put their crossed first fingers under his armpits and two others their crossed fingers under the bend of the knee.

He seriously checks that fingers are crossed; he warms his hands, rubs them on his coat and puts them close together not quite touching as if he were trying to feel some tension between them.

He explains to his audience how friction generates electricity, talks of clouds rubbing together and producing lightning, or the simple experiment of drawing sparks from dry brown paper.

HIS "LINE"

He tells the audience that he can electrify the man and thus reduce his weight by interfering with gravity. They will believe anything if it is said convincingly enough.

Having "electrified" the man by placing the rubbed hands behind his head, he very solemnly and slowly tells his lifters all to lift together on "three". Count one, two, three and up will go the man like a rocket.

The reason, needless to say, is that never before have they with confidence lifted together. You try it!

How Modern Physics Began

(Continued from Page 7)

chief. J.J. had been called to the Mastership of Trinity College, though he continued to hold a professorship and work at the laboratory until his death in 1939.

Rutherford was much stimulated by returning to the Cavendish Laboratory, and he found a keen assistant there in Aston, who was then just publishing his results on the discovery of isotopes. He continued his work on artificial disintegration, and was led by the results to throw more light on the structure of the nucleus of the atom.

Already in 1920 he was forecasting—though from erroneous data—the existence of neutrons, "heavy" hydrogen and other atomic entities.

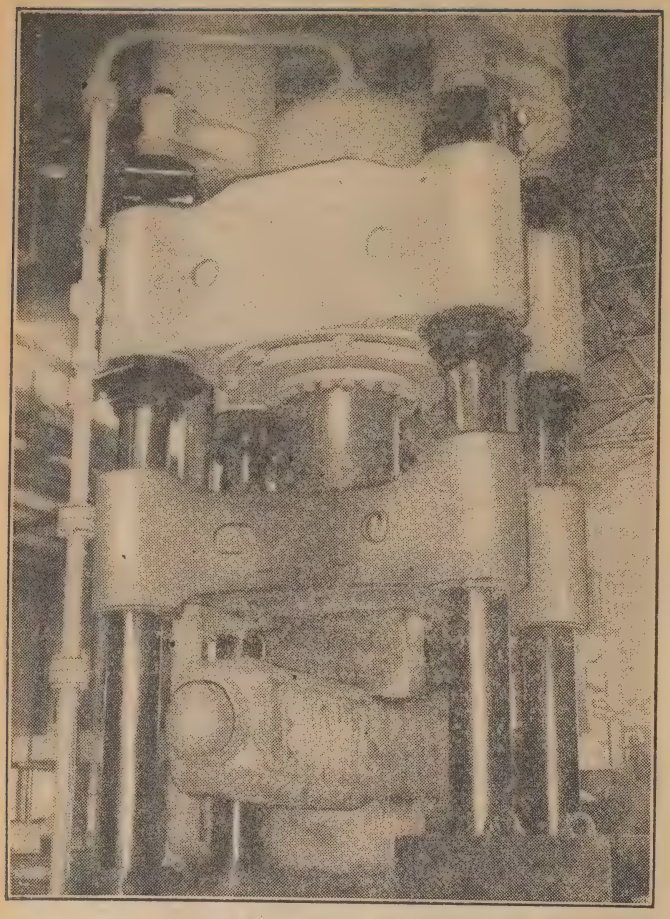
From 1920 onward the pace of atomic physics had increased so greatly that any history of the period tends to become a list of names and discoveries. In 1932 alone, Chadwick was able to confirm the existence of the neutron and measure some of its properties, and Cockroft and Walton were able to make the great two-million volt machine which could shoot protons at such high speeds as to split atoms completely artificially.

This machine with its strange and futuristic appearance, marked the beginning of a new attitude in the laboratory. Large and complicated pieces of machinery were needed for atomic research; teams of workers had to be mobilised around each device to satisfy its needs and to take from the monster all the results it could supply.

Rapidly following the apparatus of Cockroft and Walton came the development in America of the cyclotron, which provided an even more efficient gun for shooting at the atomic nucleus.

The discovery of the neutron soon led to the study by Fermi of the effect of neutron bombardment on uranium and the production by Hahn of the artificial elements beyond uranium. By the beginning of World War II nuclear physics was already very near, in theory, to the possibilities of the atomic pile and the bomb.

It required tremendous expenditure of manpower, money and scientific inquiry to bring them to success, but the basic facts of atomic structure were known. They had been elucidated by men like Thomson and Rutherford, and their colleagues all over the world. These men had penetrated the simple, hard and solid Victorian atoms, and founded a new science to explain the intricate mechanism of sub-atomic building blocks.



This picture of a 2000-ton hydraulic press shows clearly the large piston and cylinder, the 15-ton ingot resting on the anvil and the hammer guided by the four pillars at each corner of the press.

HYDRAULIC POWER IN INDUSTRY

The great progress made in the use of hydraulic power has been one of the outstanding features of engineering in the present century. There are many engineering processes which just cannot be satisfactorily carried out by any other method.

by Calvin Walters

WHEN, in the 17th century, the French philosopher and mathematician Blaise Pascal, enunciated his Law of Hydrostatics he little thought that it would have such widespread effects.

This law states: "The pressure exerted anywhere upon a mass of liquid contained in a closed vessel is instantaneously transmitted undiminished in all directions and acts with the same force on all equal areas of the surface of the vessel in a direction perpendicular to the inner surface of the vessel at any point."

There you have it, and because it says what it says we are able by means of a fluid enclosed in a vessel to raise lifts full of people, steer ocean liners, stamp out various shapes from thick metal, compress cotton and wool bales, express oils, bend iron plates and bars, raise bridges into position, lift automobiles and heavy trucks into the air, stop the same vehicles with powerful brakes, prop up the roofs of mines and scores of other things.

The term hydraulics does not necessarily mean that water is used as the motive power. This was so in the early days but nowadays all kinds of fluids are used including oil, water and glycerine, water and glycol and synthetic fluids.

Now Pascal did not live long enough to see his law put to much use for it was not until about 150 years later that an English chappie named Brahmah, working as an apprentice to a cabinet maker, had a bright idea. He invented a hydraulic press.

All he did was to enclose some water in a cylinder and pump it into another cylinder of different dimensions, whereupon the piston contained in the latter was caused to rise and lift a flat plate which was attached to it. The plate came into contact with a similar fixed plate and anything placed between was, of ccurse, subjected to considerable pressure.

HOW PRESSURE MULTIPLIES

Now this sounds a bit haywire at first, because how can the mere pumping of fluid from one cylinder to another cause an increase of pressure? Easy. Just look at the annexed figure.

Here we have two cylinders A & B fitted with pistons, or rams as they are commonly called, which are ewsed (sorry) used to apply and receive the forces.

The cylinders are watertight, and the rams slide freely in the cylinders, which are connected at the lower end by a pipe.

The cylinders are filled with fluid. It must be remembered that fluids are incompressible. This is a very important thing to remember.

Now let us imagine that ram (a) has a piston area of 50 square inches cross section and ram (b) has a piston of 100 square inches.

In the picture (a) is at the top of its stroke thus causing cylinder A to be full of liquid while (b) is at the bottom of its stroke and the cylinder B contains a minimum of liquid. It is important to digest all

this, so I will give you two minutes to read it all again while I go and listen to Jack Davey on the radio.

OK! Here I am back again. It wasn't worth listening to. Sooner have Bob Dyer.

Now you have got all this straight we will assume that a force of 50,000 pounds is applied to the top of ram (a). As the area of this ram is 50 square inches the pressure applied to the liquid is 50,000 divided by 50 which equals 1000 pounds to the square inch.

This pressure is transmitted throughout the whole liquid into cylinder B and acts upon the under surface of ram (b) in cylinder (b).

Ram (b) has to go somewhere, so it goes up, and the force acting on the bottom of this ram is 1000lb per square inch. But this ram has an area of 100 square inches, so that the total force transmitted to this ram is 1000 times 100, or 100,000lb per square inch.

As can be seen this is an enormous multiplication of force in the simplest possible manner.

Another point worthy of note is the balanced system of load and effort. This can be seen from the following:

A SIMPLE SUM

When ram (a) has fallen say a distance of 10 inches, a volume of fluid equal to 10 inches times 50 square inches (the area of this ram) passes into cylinder (b). That is, 500 cubic inches of fluid have passed into cylinder (b). Ram (b) will therefore rise a distance of 500 cubic inches divided by 100 square inches, the area of ram (b). This equals five inches rise.

Thus the work applied to ram (a) equals 10in movement x 50,000lb load equals 500,000 inch pounds. The result of the effort on ram (b) equals 5in movement x 100,000lb load equals 500,000 inch pounds.

This is a bit mathematical, but I put it in for those inclined that way. Really it is very simple.

These mathematics are the basis from which all hydraulic power transmission calculations are developed. Now I hear someone say "So what!" Well, if you are interested enough to read this far you might as well go the distance, which embodies no more mathematics.

If you look again at the diagram you can see that cylinder (A) could be a pump while cylinder (B) could be a hydraulic machine such as a press, lifting jack and so on.

All sorts of combinations can be obtained. There can be combinations of low power and long stroke, high power and short stroke and so on.

SIZE AND STRENGTH

There are devices which are attached to hydraulic systems which feed extra fluid into the system when required—valves and electrical contacts and many other extra devices. There are intensifiers which increase or intensify the pressures exerted. All these reinforce the effectiveness of the hydraulic power system to enormous figures.

The design of hydraulic machines is all a matter of size and strength. Needless to say if a cylinder has to withstand pressures of say 12,000 tons per square inch it must be pretty strong. Many presses do indeed apply pressure of this nature and they are enormous structures.

It is easy to see that the only limit to the pressures that can be generated lie in the ability of engineers to make cylinders strong enough to withstand them.

Imagine instead of the simple apparatus described above, a machine consisting of a ram with one cylinder as before applying a pressure of say 100 tons per square inch to the larger plunger. This latter could be used to apply pressure to a second system and so on. The pressures could be applied indefinitely so that fantastic pressures could eventually result.

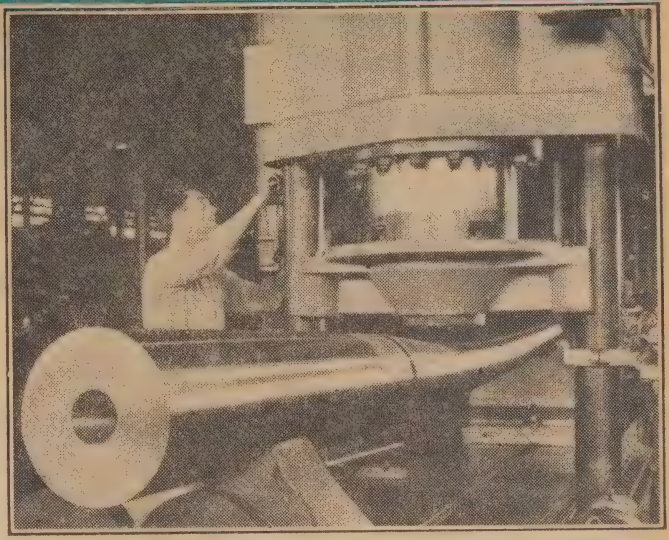
Hydraulic presses have superseded the old steam hammer, which was a noisy affair. It consisted of a heavy weight which was dropped onto the red hot metal to be forged. Present day technique uses a hydraulic press, which not only applies far greater pressure but which is almost noiseless.

Some presses used in powder metallurgy can press powdered metal into a mass so solid as to be almost indistinguishable from a piece of cast metal.

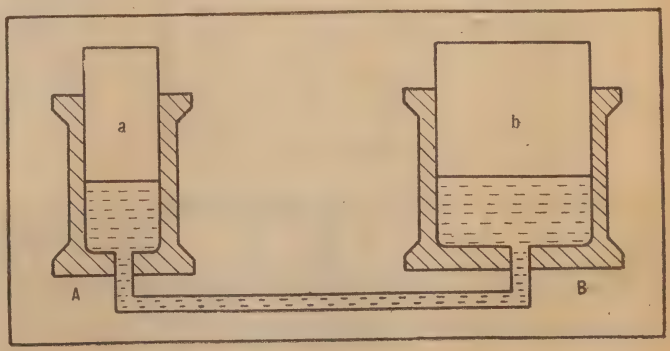
By means of dies the powder is shaped by filling the die and applying pressure with a hydraulic press. The result is mostly better than forging or casting because of the lack of flaws and distortion by heat and so on.

Today it is possible to obtain

CANNON BARREL UNDER PRESSURE



Some idea of the great pressure exerted by even a small press is illustrated by this picture of a big gun barrel being straightened. One can imagine the great force needed to bend the barrel.



This diagram illustrates the principle of the hydrostatic force multiplier.

metal sections of an infinite variety of shapes. These are usually made by forcing solid metal through dies by means of hydraulic machines.

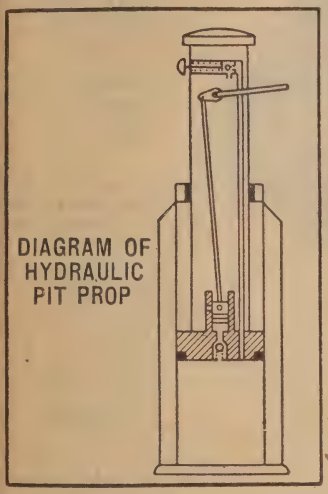
In the forming of large panels for cars and aircraft a stretching press is usually employed. The sheet of metal is first roughly shaped into the required profile in the flat. This is then held by grips along the four sides and laid in the flat over a die. A hydraulic ram then applies the necessary pressure and so stretches the metal into the required shape.

In the rubber industry where moulding and vulcanising play an important part hydraulic presses are used almost exclusively, and the very long life of a present day motor tyre is due to a large extent to the very effective bonding of the various layers made possible by the great pressure available from the presses.

The plywood industry is dependent upon hydraulic presses for the high quality of modern bonded woods.

Some interesting applications of hydraulic power exists in the mining industry, two notable examples being the hydraulic burster and the hydraulic pit prop.

In order to obviate the dangers



attendant by explosive charges for blowing down a face of coal in a mine, the hydraulic burster was developed.

Explosives can ignite dangerous gases and cause disasters. It can shake the foundations of the roof and cause these to collapse.

The hydraulic burster consists of a round stainless steel bar with chambers at intervals containing a series of telescopic pistons which act at right angles to the axis. These are prevented from coming right out by means of stops at the inner ends.

In use, the burster, which is about 2¾in in diameter, is placed in a hole about 3in diameter, previously bored in the coal or rock.

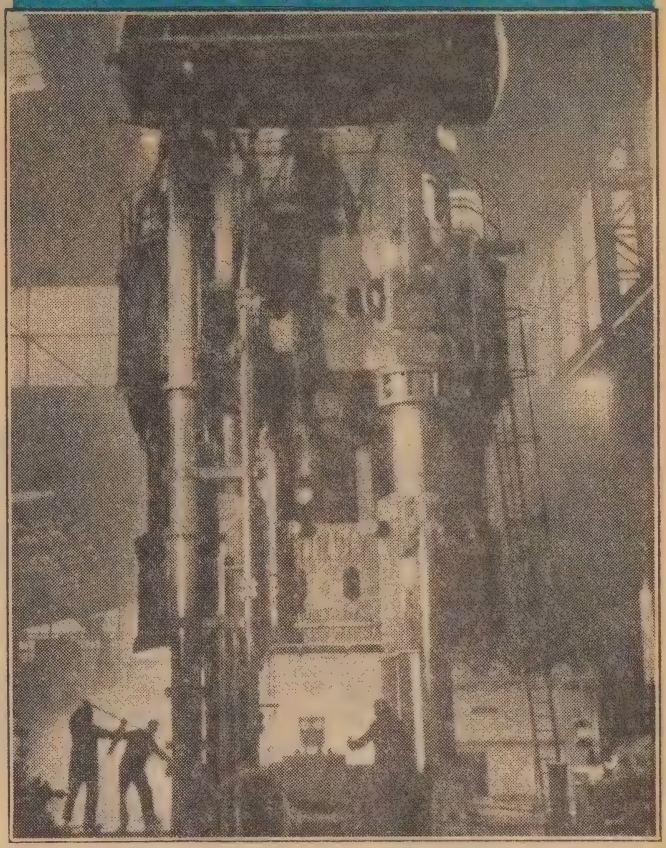
The burster is connected with a hose to a pump at a safe distance and pressure applied. Pressures of up to six tons per square inch are applied and the effect is to literally burst the seam of coal asunder. Up to 20 bursts per hour can be achieved with one burster which is, of course, recovered from the coal afterwards.

The hydraulic pit prop is rapidly finding favor because it does away with expensive timber propping of the roofs of mine tunnels. It is really a single acting hydraulic jack with a built-in manually operated pump.

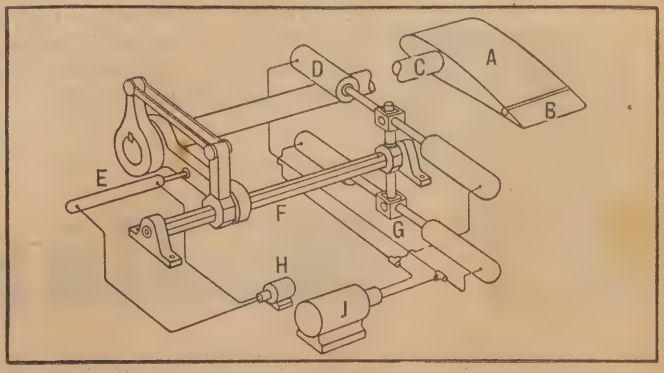
It can be extended from 23 to 92 inches and has at the top a fric-

(Continued on Page 79)

12,000 TON PUSH FOR AIRCRAFT

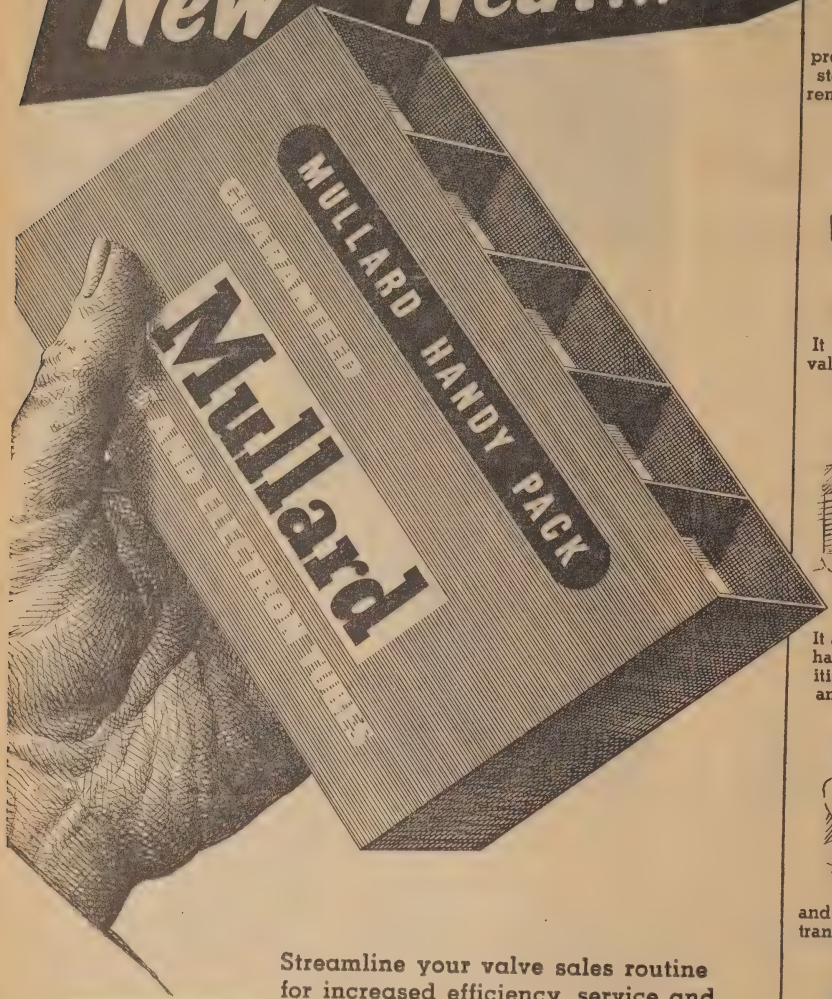


One of the largest presses in Europe, this monster creates a push equal to 12,000 tons and is used for fabricating light alloy parts for the aircraft industry. It is 42ft 9in high, with a 13ft 7in section underground. It cost £500,000 to build and instal.



This diagram illustrates the principle of the Denny-Brown ship stabiliser.

New Neat...



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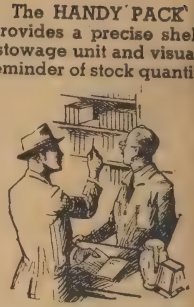
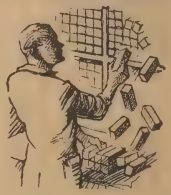


It facilitates systematic valve ordering, packing and despatching.

It allows rapid and easy handling of large quantities of cartoned valves and eliminates this . . .



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Mullard HANDY PACK

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Technical Review

NEW EYE MAGNET REMOVES NON-FERROUS PARTICLES

The idea of using magnetism to remove particles of copper, brass, aluminium &c., from the eye may, at first glance, appear to be among those things normally rated as "impossible". Emphasis on the idea that nothing is really impossible any more is given by a report from the United States of a device which does just this.

EYES penetrated by particles containing sufficient magnetic material are usually saved by the ordinary electro-magnet; eyes penetarted by fragments of non-ferrous metals are commonly lost.

Development of a magnet for non-ferrous metals, first operated on 60 cps and used to pick up relatively large objects such as silver coins and copper rings, resulted in a study of possible application to eye surgery. Tests were made on particles of brass, lead, aluminium and copper suspended by threads, using an oscillator and 30-watt amplifier.

HIGHER POWER NEEDED

Results were promising, but indicated need for relatively high power over a considerable frequency range. Facilities for testing at 2 kilowatts were provided. Using that equipment, a 2mm copper wire clipping was moved about 3mm through cow-eye vitrous (jelly-like substance filling the posterior chamber of the eye between the lens and the retina) in a tray.

The office of the Surgeon-General of the US Army became interested when it developed that about 25 pc of the numerous eye injuries in the Korean conflict due to metal fragments involved non-magnetic metals.

The new electromagnet has been developed to a point at which particles of copper, aluminium and magnesium have been extracted from the eyes of animals, using a water-cooled electromagnet supplied from a 25 Kw amplifier at 5 to 10 Kc.

When a simple coil carrying alternating current surrounds a closed conductor or a short-circuited coil, and a conducting object (the particle to be attracted) is adjacent to the inner member (see figure 1) currents of substantially like phase are induced in the object and the inner fixed member, setting up attraction forces between them.

ATTRACTION ZONE

With proper configuration and geometry there is an attraction zone approximating a cone with its base in the surface of the structure. A conducting object situated so that the principle induced current paths lie within this region will be attracted by predominance of the attractive force over repulsion. Outside this zone there is repulsion.

This simple form is shown in figure 1, in which the attraction zone for large objects is shown in dotted lines. The model shown in the figure has a central magnetic core filling, an opening in the attractor, and also an intermediate core between the attractor and field coil, which intensifies the field of the main coil.

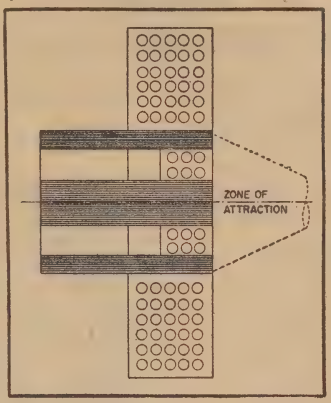


Fig. 1. Details of the non-ferrous magnet showing the cone shaped space in which effective pull occurs. The device is still in the experimental stage.

The power plant is rated at 25 Kw from 3 Kc to 12 Kc and the useful range can be extended to 50 Kc by changing the driver power transformer. (Figure 2.)

POWER CONTROL

The power level of the large amplifier output is set by the output control of a variable frequency oscillator which fixes the voltage impressed on the input to a 20 watt preamplifier.

A tapered coil, 4in outside diameter, 1½in inside diameter, wound with .06 by .04in copper tubing, using 8000 ampere turns, without the intermediate core and with attractor open circuited, creates a field of 2000 gauss at 1cm out on the axis.

The pull on a 2mm particle of copper in this arrangement, but with intermediate core and 7-8in attractor, is measured at 20 times gravity at 7-mm from the attractor aperture and off centre where the pull is great.

No trials have been made with human eyes, but the near term outlook seems to be favorable for objects 1mm or greater in the smallest dimension, especially those of copper or aluminium, if early operation can be provided. (Electronics, Sept., 1955.)

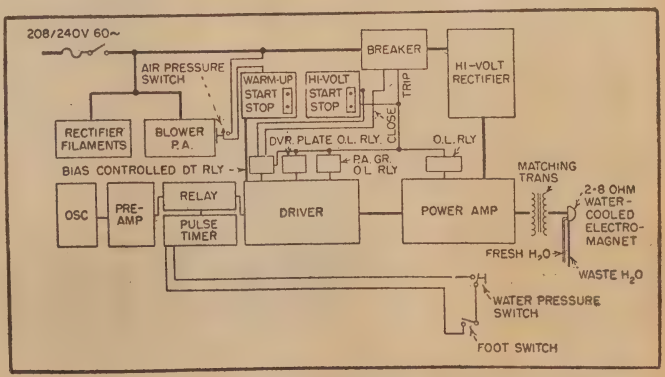
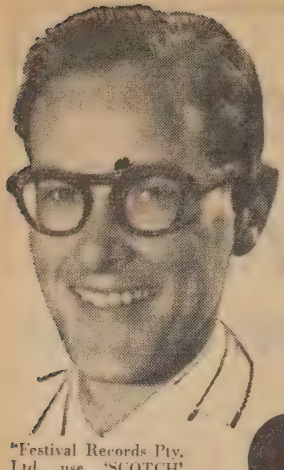


Fig. 2. Simplified diagram of the oscillator and amplifier used to power the non-ferrous magnet. Note the provision for water cooling in the magnet proper and which is dictated by the high power involved.



"Festival Records Pty. Ltd. use 'SCOTCH' Brand Sound Recording Tape Exclusively" says Mr. R. Iredale, Recording Engineer.

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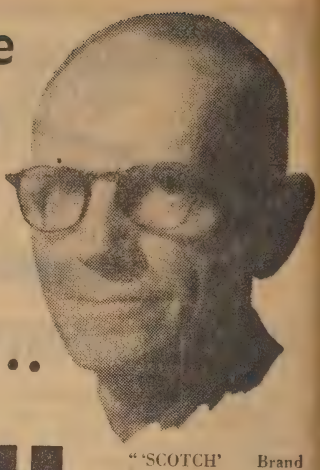

"'SCOTCH' Brand Sound Recording Tape is used by 2GB Macquarie" says Mr. H. K. R. Thomas, Chief Sound Recording Engineer.

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Rigid manufacturing standards, continuous research and testing . . . analysing . . . testing . . . analysing . . . over and over again, always add up to the same answer. "SCOTCH" Brand Sound Recording Tape is the No. 1 sound recording tape on the market. Ask for it . . . look for it in the distinctive plaid decorated box. It costs no more and the brand name "SCOTCH" is your assurance of sound quality. Insist on "SCOTCH" Brand Sound Recording Tape.

Enjoy These "Scotch" Features

1. "SCOTCH" Tape is wound on precision spools of international standard. Slit to wind and track evenly.
2. Low-stretch factor and adequate strength.
3. Gives more output for a given input.
4. "Dry" lubricated, preventing sticking to the recording and assuring long wear.
5. Widest frequency response and maximum saturation level.
6. Minimum distortion —maximum signal to noise ratio.
7. Unequalled uniformity reel to reel.

ANOTHER 3M PRODUCT

MINNESOTA MINING AND MANUFACTURING (AUSTRALIA) PTY. LIMITED, ST. MARYS, N.S.W.

NEW ALUMINIUM-IRON ALLOY IMPROVES TAPE HEADS

One of the biggest problems in producing satisfactory tape recording and playback heads is to find a core material which combines physical hardness, to reduce wear to a minimum, with the most desirable magnetic qualities. These two normally opposing qualities are combined in a new alloy announced in the United States.

ALFENOL, a binary alloy of between 10 and 16 per cent aluminum with the balance iron, is one of the first high-aluminium content aluminium-iron alloys to be produced in a thin, ductile cold-rolled sheet form.

That such alloys possess good soft magnetic properties has been known for many years. However, owing to their extremely hard and brittle character, they could not be produced in sheet form suitable for fabrication into laminations for magnetic structures.

UNUSUAL QUALITIES

A material that is magnetically soft and physically hard is unusual. This is evidenced by the fact that a physically soft material is used in practically all applications of magnetic recording and reproducing.

Ferrites employed in an effort to circumvent the head wear problem have not, despite their physical hardness, had entirely suitable magnetic properties. In addition, other problems of physical and magnetic nonuniformities lead to fabrication or

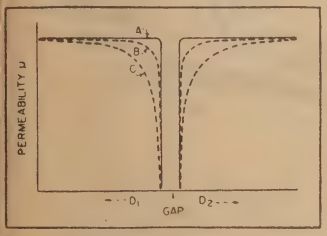


Fig. 1. Showing the difference between the physical and effective magnetic gap with typical materials. The solid line represents the ideal case.

other difficulties that may result in inferior units.

On the basis of both electrical resistivity and hardness, the new material possesses exceptional properties, particularly for an application such as record and reproduce heads. The extremely high electrical resistivity gives a low eddy-current loss value.

Hardness approaches that of tool steel. Because of the material's extreme physical hardness it resists degradation of its magnetic properties through strain induced in processing and handling.

In the as-rolled sheet form, Alfenol has a very thin, tightly adherent film of aluminium-oxide on its surface. This film in turn forms an excellent surface insulation when laminations punched from the sheet stock are stacked.

Several experimental units were used in this investigation. The heads were fabricated from 0.006in cold-rolled sheet stock using conventional fabrication techniques. To measure accurately the physical-vs-electrical gap spacing, high-precision, hard-temper beryllium-copper foil was utilised as a spacer material. Foil thicknesses varying from 1000 to 230 micro-inches were used.

Although several core configurations were made, most of the data here reported was taken on units having a core 0.7 inch inside diameter and 1 inch outside diameter.

The electrical resolution of the units was measured at a tape speed

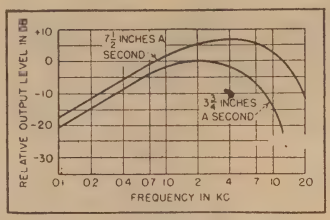


Fig. 2. Frequency response of the new tape head with 230 micro-inch reproducing gap.

of 3.75in a second by determining the frequency at which the first null appeared. This null in head output occurs when the recorded wavelength on the tape is equal to the electrical gap dimension of the reproducing head.

In all new alloy units measured, it was observed that the electrical resolution and physical gaps were practically the same.

The physical measurements were made by directly measuring the gap under an optical microscope using a Filar-type eyepiece that had been calibrated by a precision ruled stage. Comparison of the two shows a close correlation for the Alfenol units.

The excellence of Alfenol in holding an electrical resolution nearly the same as the physical resolution is accounted for, in part, by the fact that during the lapping of the gap faces little loss in magnetic properties is incurred.

LAPPING PROBLEMS

It is known that a lapped surface is severely cold-worked. This cold-working results in virtually complete loss of high permeability in the material. However, due to the new material's extreme hardness, the depth of the cold-worked permeability loss is apparently small.

A softer material has a tendency to flow or smear, resulting in a much deeper penetration of the cold-worked surface. Thus a limitation is established on electrical resolution that is caused by the loss of magnetic properties of the inner surface of the gap. This permeability boundary creates an apparent air gap with poorly defined limits.

This effect is illustrated in Fig. 1. Here curve A represents the ideal case, where the core material permeability remains high and abruptly drops to a value of 1 (that of air) at the gap insert.

Curve B shows the effect of a slight permeability surface, while curve C illustrates a more severe or deep boundary that would result from excessive cold working. From a comparison of the electrical and physical gaps it may be concluded that Alfenol shows this effect only slightly and would be represented by a curve like that of B.

Figure 2 shows the frequency response curves for an Alfenol unit with a 230-microinch physical gap. That the electrical resolution of this unit approaches very closely the physical gap is apparent from these curves.

PRACTICAL CURVES

High electrical resistivity should result in a considerable decrease in core losses for record and reproduce units employing this material.

To check this, a single frequency of 5000 cycles was recorded at a tape speed of 5in a second, using a standard head. The tape was then played back, using an Alfenol reproduce head, at speed increments to obtain playback frequencies of 5, 10, 20, 30, 40, 50 and 60 kc. For comparison, a duplicate set of measurements was

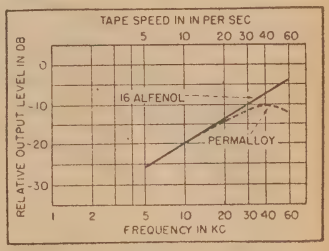


Fig. 3. Graph showing comparative losses of permaloy and Alphenol heads. In the latter case there is no appreciable loss at 60 Kc.

made, using a conventional playback head.

Results of these tests are shown in Fig. 3. Up to a playback frequency of 60 kc (the limit of the measuring equipment used), the new unit showed no deviation from the normal 6 db per octave rise, as compared to a drop of approximately 7 db in the other unit at 60 kc.

The three advantages of wear resistance, increase in resolution, and decrease in core losses of the new material all combine to make its use extremely promising for video recording on tape. Here high tape speeds, the need for high-frequency reproduction at low losses and especially the requirement for high resolution in the reproduce head all fall in line with available properties.

("Electronics" — June, 1955)

NEWS AND VIEWS OF THE MONTH

Ice projectiles

THE use of ice bullets to remove one's enemies has been the subject of comic strip writers for a long time, but now a possible practical use of a similar idea has been suggested by a USA scientist.

He is Dr. Lincoln La Paz, Director of the University of New Mexico's Institute of Meteoritics.

"In range-testing inter-continental ballistic missiles in peacetime, a shrewd opponent for obvious reasons would seek to employ test objects leaving no tangible trace of their existence or use," he said.

Dr. La Paz said that since 1948 representatives of the Institute of Meteoritics had been investigating luminous phenomena seen in the sky.

They had asked observers if pieces of ice or drops of water were seen falling from the sky at the time of the observed incident.

Dr. La Paz said an ice projectile could be shot from a plane at high altitude many miles away from the US.

The ice projectile, melting rapidly as it shot, through the atmosphere, then would be photographed or traced by radar.

The opponent then would have a fair idea of where the real thing would hit.

TV "cuts crime"

RELIEF from the many reports of the evils of television to modern youth was provided by a recent report from England. It states that many welfare officials believe that TV, at home and in youth clubs, has helped cut juvenile crime by keeping young people off the streets.

Remand home officers at Brentwood (Essex) say the postwar peak in child crime is over.

The Brentwood home's capacity for 40 boys has often been overtaxed in the past few years. Now there are only 20 boys in the home.

Several other remand homes throughout the country have been closed in the past year.

Warming the Arctic

VAST man - made geological changes were predicted by a Russian engineer recently. One project being considered was to lock the gateway between the Arctic and Pacific Oceans with a mammoth dam across Behring Strait.

A battery of hundreds of giant pumps would pour a tremendous amount of water from the Pacific into the Arctic Ocean.

This would produce an artificial warm current about equal to that of the Gulf Stream, greatly moderating the climate in the Arctic zone and north-eastern Asia, he said.

The permanent Siberian, anticyclone could be broken.

Asia, North America and part of Europe would escape the frigid breath of the Arctic.

Transistors at UHF

IMPROVEMENTS in techniques by the Bell Telephone Laboratories have resulted in the manufacture of experimental "npn" type transistors for use at frequencies exceeding 1000 megacycles. This has been made possible by the reduction of the thickness of the central "p" layer to less than .0002 of an inch in width. This transistor is of the tetrode type.

In addition to these details of the Bell Telephone units other transistors of the tetrode type are available from other USA companies for operation in the video and vhf frequencies.

More image othicons

TWO other companies have now joined RCA as manufacturers of the image othicon tube. These are General Electric and Westinghouse. The major difficulty in the manufacture of these tubes is in the target and mesh assembly.

It consists of a copper mesh of 500 wires to the inch, spaced two thousandths of an inch from a glass membrane which is the target. This target itself is between one and two-tenths of a thousandth of an inch in thickness.

Solar energy

THE use of solar energy for hot-water systems, refrigeration, and the distillation of brackish water in the outback of Australia was predicted by Professor A. H .Willis on his departure for America recently. Professor Willis, who is the Professor of Mechanical Engineering at the Sydney University of Technology, was on his way to the USA to attend the first international conference on the uses of solar energy.

He predicted that a heater suitable for use in outback areas would initially cost £70 but that the heater would cost nothing to run.

The major drawback to the system is its unreliability for, unless the sun shone, there would be no output. For this reason the professor felt that this form of energy would not replace the use of electricity where this was readily available.

Off-shore radar

THE first of the American offshore radar warning stations is steadily going ahead at a location one hundred miles east of Cape Cod. A number of these radar towers are to be built at points approximately one hundred miles off the east coast of the USA.

These stations will operate in conjunction with the Continental Air Defence Commands shore based stations, and will be fitted with both search and height finding radar systems.

The first of these stations has a main platform supported 87 feet above the water level to be out of the reach of large waves. The main steel platform itself weighs 6000 tons.

In addition to all the radar equipment that has to be housed, accommodation has to be provided for 70 personnel who will be stationed at the site for periods of up to 30 days at a time.

POPULAR SCIENCE QUIZ

Q. What is reverse TVI?

A. This is the interference caused by television receivers to other TV receivers or radio receivers. It is caused in the main by harmonics of the line frequency oscillator and by local oscillator re-radiation.

Q. Can television be wired to homes in the same way as radio programs are in some overseas communities?

A. Yes, it can be done but the problems are much greater than for radio programs due to the higher fequencies involved. Such systems can be used in a large hotel where there is one main receiver and the other units are merely slave units.

Q. Is it economical and practical to use a common tower for two television stations?

A. It is practical and considerable savings can be achieved. This is because for maximum coverage, the aerial needs to be as high as possible. It is reaching this height that the major cost is involved. Once this has been accomplished it does not require much additional expense to add an additional radiator to the tower. Such an installation is at the present moment being carried out in Cuba where two RCA 10 Kilowatt television transmitters are being coupled to a common mast. This mast is supported on the roof of a new 23-storey hotel and the stations will transmit on Channels 4 and 6.

In New York, several television stations radiate from the summit of the Empire State Building. It has the additional advantage that all receiving aerials can be directed toward the one point, thereby eliminating the need for rotating aerial arrays.

Q. What is a camera light filter and what is its purpose?

A. It is a piece of tinted glass or tinted gelatin sandwiched between two layers of glass. Its effect is to modify the tones of black and white in a photograph. It can be used to highlight certain effects in the scene being taken such as to improve the cloud detail in an outdoor shot.

New Release

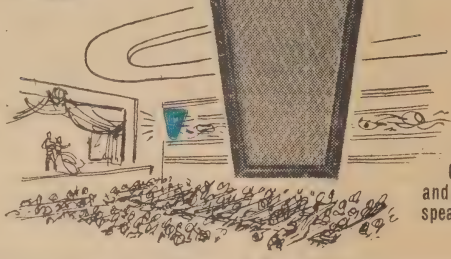
SOUND REINFORCEMENT SPEAKERS
FOR CONTROLLED SOUND DIFFUSION

The line source principle, combined with the especially developed A.W.A. speaker units and cellular acoustically damped inverted pyramidal housing, make possible a polar pattern of projection which puts the sound where it is required, and a response character which makes sound live.

PA 344
Speech range low-level speaker.

PA 343
General purpose music and speech medium-level speaker.

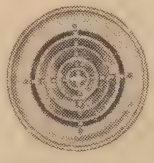
PA 342
Wide range medium level speaker.



PA 353
Weather-resistant for outdoor and industrial applications. General purpose music and speech medium-level speaker

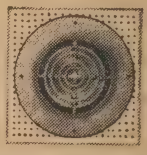
Models PA 342, 343 and 344 for indoor applications, and Model PA 353 for outdoors, are the product of extensive acoustic research by A.W.A. development engineers. Wide angle coverage horizontally, with narrow beam vertical plane projection, plus smooth frequency response, ensures far more effective reproduction without reverberation. No resonances to cause feedback and boom, no valleys to make voices unreal.

PA 188—
For surface mounting.



PA 187—For flush mounting with small surround. The face panel and louvre project slightly below the ceiling line.

PA 218—
Is for suspension by chain or rod.



PA 186—For flush mounting has a recessed surround which mounts the complete assembly above the ceiling line.

A.W.A. offers the most comprehensive range of speaker assemblies for every requirement in audio reproduction.

All models are planned for optimum faithfulness of sound reproduction in keeping with physical and cost requirements. Special designs are included for high power projection in open space, and also for wide angle, wide audio range fidelity.

A complete range of audio system basic units is available . . .

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

47 YORK STREET, SYDNEY — **167 QUEEN STREET, MELBOURNE**

Available in other States from

Newton McLaren Ltd., Adelaide. Noyes Bros. (Melbourne) Ltd., Hobart. Chandlers Pty. Ltd., Brisbane.
Nicholsons Ltd., Perth. Also from leading wholesalers.

PA1-55.

Glass-plastic bond

CHEMICAL bonding can join plastic and glass more solidly than the usual glues and cements. The bonded materials can be made into laminated panels that hold together through repeated test foldings, showing that the finished material combines plastic's flexibility with the strength of the glass fibres.

Part of each of the new compounds will unite chemically with one of the plastic materals while another part will join the structure of glass.

Aeroplane bodies, boats and cars in the near future may be made of glass and plastic chemically bonded together. Five new bonding compounds, all belonging to a class known as chlorosilanes, have been developed to combine with the different types of plastics.

TV imports

THE Federal Government will allow the import of television receivers on a restricted basis.

Announcing this, the Minister for Trade and Customs (Senator O'Sullivan) said the Government was not establishing new import licensing quotas for television receivers.

The Government would issue import licences for receivers from other than the dollar area to "B" category quota holders—against their existing quotas. However, it would restrict the maximum number of sets to be licensed to any "B" category quota holder to 200 a quarter.

Senator O'Sullivan said importers would have to declare that the sets conformed to the standard specifications at the Broadcasting Control Board.

The Government would also have to issue licences for the importation of picture tubes in the early stages of TV set manufacture in Australia.

The Commonwealth would not establish quotas to import these tubes, but would consider applications from individual manufacturers.

The number of tubes imported would depend largely on manufacturers' estimates of probable sales.

The Commonwealth had made an allocation from July 1, 1955, of overseas currency to import components for TV sets.

TV for schools

THE use of television to offset the shortage of teachers in schools was commented upon by Miss Kinnane, Script Editor and Producer for the ABC's Youth Education Department on her recent return from three months in Canada and USA.

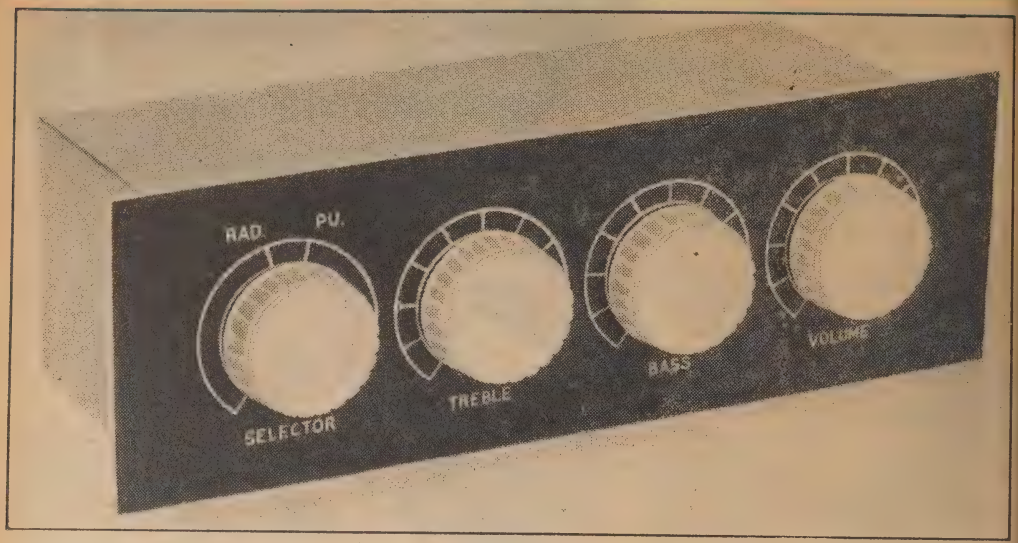
She said Americans were becoming increasingly aware of the fascination TV held for children.

The New York Board of Education, as well as many universities, school and community television stations, ran special programs for schools.

Most popular courses included arts, languages, history, geography, literature, and music.

Shop at home!

TELEVISION in the USA continues to find applications to mediums other than entertainment. The latest is an aid to "shopping at home". Articles which are televised on the screen can be ordered from the shop in the same way as the week-end groceries.



The front panel showing order of controls. There is a panel light at bottom centre.

CONTROL UNIT FOR CRYSTALS

Here is a simple but effective control unit for use with crystal pickups and the Playmaster series of amplifiers. It has no preset compensation, but a wide range of bass and treble adjustment which will accommodate most standard pickups.

FOR various reasons our readers frequently strike trouble when attempting to use crystal pick-ups with Playmaster amplifiers.

Invariably they have merely connected their pick-up to the control unit input terminals and imediately struck trouble.

The control units concerned were designed primarily for pick-ups of the magnetic type with an average output of not more than about 100 millivolts.

The input resistor for such pick-ups is generally about 25,000 ohms, and a resistor of around about this value was used with most of the units.

However, the intention was that the initial resistor should be of the correct value specified by the manufacturers for the pick-up used. Particularly if an input transformer were used to couple the pick-up, its value might be considerably higher.

Connecting the average crystal pickup into a low load of 25,000 ohms or less causes it to behave very much like a magnetic type in that the bass end is greatly reduced in output.

This isn't an entirely satisfactory solution, however, unless a value is found which provides the right turn-over point for the bass response, at the same time reducing the over-all output sufficiently to avoid overloading the grid of the pre-amplifier valve.

It is clear that this overloading has taken place in many cases reported to us. Reference to the graph on this page will illustrate the point. Reducing the pickup load has quite clearly altered the bass characteristics, but has affected the response very little over about 2 Kc.

OVERLOAD DANGER

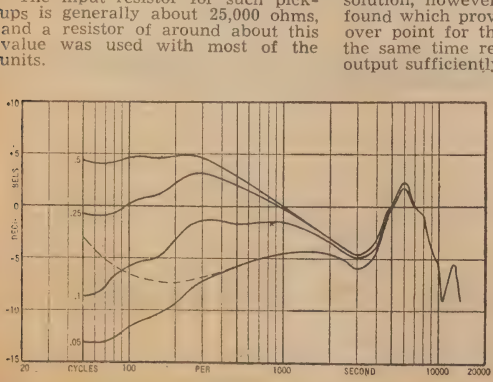
As most crystals show a peak of some kind following this point, the danger of overloading in this part of the frequency response is obviously most probable, even on LP records.

It is inevitable in the case of those readers who have blithely connected a .5 meg resistor at the input of the amplifier and hoped for the best.

Quite a good idea, which we have often suggested, is to replace the initial grid resistor with a .05 potentiometer connected across the pick-up terminals, the control unit grid connection being made to the moving arm.

The .05 meg is enough to flatten down the bass response more or less to reference, and the moving arm is set to that position which gives adequate output voltage from the pick-up.

The control unit is then used in the normal manner, remembering



This graph shows how the GP-20 head changes characteristics with change in load.

A side view showing the position of many components in our unit.

hat, because few crystal pick-ups have a flat response, the various ompensation settings will not be particularly accurate.

It has long been obvious, therefore, that a special control unit for rystal pick-ups which would operate with the Playmasters in the normal manner would be a very good thing, and would be a great help to readers who have pick-ups of this type.

The publication of some amplifier and radiogram circuits using a tone control borrowed from the Mullard amplifier led us to believe that the entire front end could be successfully adapted as the basis of a suitable unit.

SIMPLE CIRCUIT

In general terms, this arrangement connects a simple resistance-capacitor network immediately between the pick-up and the first valve, which allows both bass and treble boost and cut to be obtained in addition to a volume control.

There is considerable loss in the compensation circuit, so that the voltage available for the valve is quite small—estimated at about 50 millivolts from an input of about 600 millivolts.

This would represent the probable peak limit of voltage output from the pick-up, and the drop of about 12-1 in the compensation circuit virtually guarantees that the following valve is quite safe from overload under any circumstances.

Now the average input sensitivity of a Playmaster is from 250 to 350 millivolts—some might need a little more than this. We estimate that this is about the right degree of sensitivity to allow it to be fully loaded from the average crystal with an adequate safety margin.

So that if we arrange for the overall gain of the control unit to be unity, that should work out quite nicely.

Obviously this means that, with a loss of about 12 in the compensation, the pre-amplifier valve in the unit should have a gain of 12 to make up for it.

This is accomplished quite easily by using a triode-connected EF86 as a pre-amplifier.

Any triode having a similar gain can be substituted, but the EF86 has proved itself an excellent low noise performer with very little if any tendency to microphonics.

A 6AU6, for instance, would be a satisfactory substitute, and its gain should be about the same with the same plate load. The low input voltage which the grid is required to handle renders the circuit non-critical as to exact operating conditions, and even with the grid bias removed a little from optimum, the distortion should be negligible.

As mentioned in previous articles dealing with this type of input circuit, exact compensation for crystal pick-ups, apart from perhaps one or two special types, is rather a futile business, because the output curve is not only far from flat but is rather unpredictable from one cartridge to another, and even between different samples of the same type.

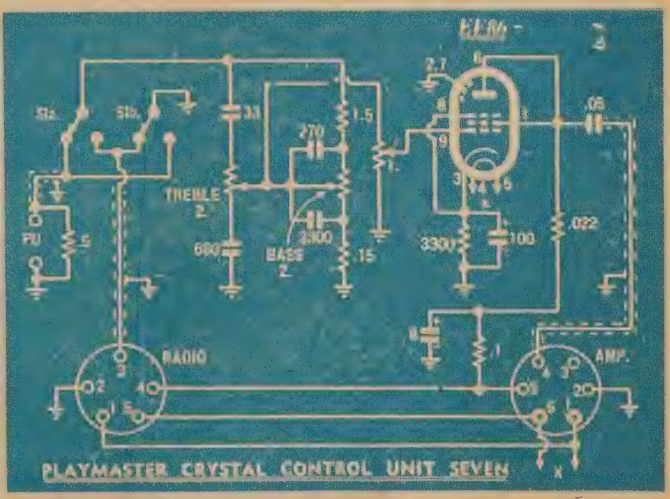
The curve already referred to, although representing quite a good make of pick-up, illustrates the formidable job involved in flattening out the response.

UNIFORMITY

Experience has shown that, although reasonable success has been obtained by specific compensation circuits for certain pick-ups, the results are actually worsened unless the cartridge used is reasonably close to optimum. This is often a doubtful assumption.

It is far less trouble, and in general more satisfactory in the long run, to operate the pick-up into a load which reasonably restricts the bass, and then to adjust the balance by continuously variable controls which allow boost or cut of both bass and treble.

This is exactly what this unit has been designed to do.



The circuit is exceedingly simple. The overall gain of the unit is approximately unity. The .5 meg pickup load resistor will suit most pickups, but can be varied if desired.

"ACOS" CRYSTAL MICROPHONES and MICROPHONE INSERTS

A Complete Range For Every Purpose

DESK or HAND MICROPHONE

MIC 36

Housed in attractive plastic case, this Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni- directional frequency response substantially flat from 30 to 7000 c.p.s. Recommended load resistance not less tnan 1 megohm dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor as required at a small extra cost.

£6/18/6

HIGH QUALITY MICROPHONE

MIC 16

Designed to meet even the most exacting requirements, this Microphone incorporates the world famous floating crystal sound cell construction. Its special characteristics are that its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise.

SPECIFICATION

Recommended load resistance—not less than 1 megohm.
Output level —65 db ref. 1 volt/dyne/cm².
Frequency response—substantially flat from 30 c.p.s. to 10,000 c.p.s.
Directivity—non-directional.
Size—2-1/8in spherical diameter.
Connector—Standard international 3-pin.

£24/19/6

GENERAL PURPOSE

MIC 35

The MIC 35, undoubtedly the best value ever offered, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5000 c.p.s.

£2/15/-

SPECIFICATION

Output level: —55 db ref. 1 volt/dyne/cm².
Cable—approx. 4ft. of co-axial supplied.
Weight—6ozs. unpacked, 7 ozs. packed.
Dimensions—microphone only 2¼in x 2¼in x ⅞in.

TABLE or STAND MICROPHONE

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the quotation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost.

MIC 22

SPECIFICATION

Output level = —50 db ref. 1 volt/dyne/cm².
Output impedance—equivalent to approximately 0.002 uF (0.8 megohm at 100 cycles).
Frequency response—substantially flat from 40 to 6000 c.p.s.
Recommended load resistance—not less than 1 megohm, dependent on low frequency response.

£9/18/6

LAPEL MICROPHONE

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.

MIC 28

Output level—approx. —55 db ref, 1 volt/dyne/cm².
Recommended load resistance—5 megohms.
Frequency response—level throughout the whole of the audible spectrum.
Capacity—0.0015 uF. at 1000 c.p.s.
Impedance—100,000 ohms at 1000 c.p.s.
Cord—6ft. shielded cable.
Size—1-9/16in wide x 2¼in long x 5/8in thick.

£5/19/6

HAND or DESK MICROPHONE

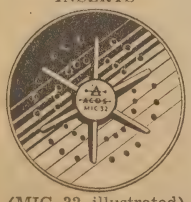
This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7000 c.p.s.

MIC 33

£6/18/6

CRYSTAL MICROPHONE INSERTS

MICROPHONE INSERTS



(MIC 32 illustrated)

These inserts are available in varying sizes ranging from as small as 15/16in square to 1-13/16in round, with various thicknesses from 7/32in to 9/16in. Suitable for every purpose such as hearing aids, public address, tape recording, amateur broadcasting, etc., they have responses from 2250 c.p.s. to 3500 c.p.s. at 5 db to 30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC 19/4 and MIC 32, **£2/15/6**; all other, **£1/19/6.**

MICROPHONE INSERTS

(MIC 23 illustrated)

SOLE AUSTRALIAN AGENTS:

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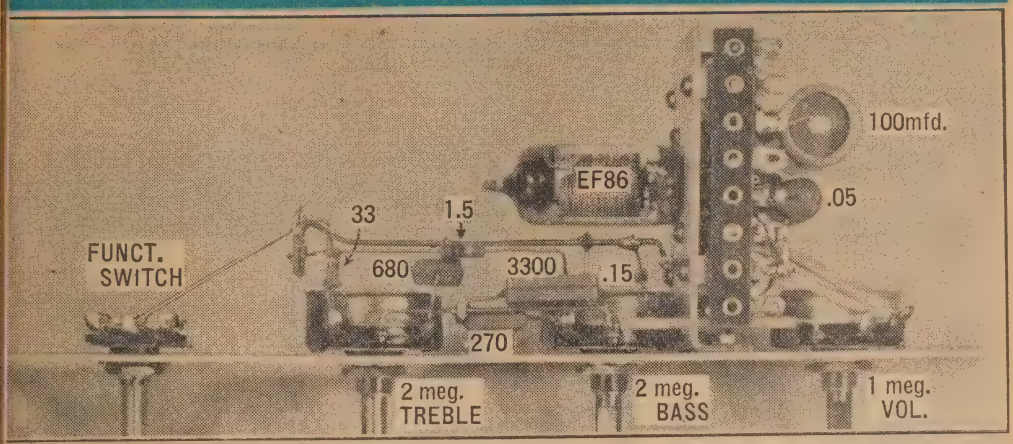


Another view from the side. The panel light was not fitted when the picture was taken.

There is no reason why you should not experiment with various kinds of compensation circuits for the pick-up should you so desire, remembering, however, that such circuits nearly always involve further attenuation of the actual pick-up output voltage, and may leave you without sufficient drive to satisfactorily load up the amplifier.

BEST LOAD

The best load value will be that which gives the right amount of bass with the bass control in its mid position—that is with no appreciable bass or cut. This will enable you to add or subtract from this setting by a useful amount in each case.

The actual resistor value will probably lie between .5 and .2 megs, and you will be well advised to experiment for the best effect.

The range of control with the circuit constants given is from 11 db of boost at 20 cycles to 5 db of cut, and from 10 db of boost at 10 Kc to 10 db of cut. At approximately mid-position the controls are inoperative. As with practically all continuously variable controls there is some inter-action between them at the 1 Kc point, but it is not enough to be serious.

PARTS LIST

1 Panel and shield box as for Control Unit No. 6.
1 EF86 valve.
1 2-position switch.
2 2-meg potentiometers.
1 1-meg potentiometer.

RESISTORS

1 1.5 megs, 1 .5 megs, 1 .1 megs, 1 .022 megs, 1 3300 ohms, all ½ watt.

CONDENSERS

1 3300 pf, 1 680 pf, 1 270 pf, 1 33 pf all mica or ceramic. 1 .05 mfds 400V, 1 8 mfds, 350V, 1 100 mfds, 40V.

SOCKETS

1 Noval, 1 6-pin, 1 5-pin.

SUNDRIES

4 Knobs, panel light bracket and bezel, 2 8-terminal tag strips, 1 3 terminal tag strip, hookup wire, 1 ft 16 or 18 gauge tinned copper wire, 6 round head ⅛in nuts and bolts, 6 countersunk ⅛in nuts and bolts.

Constructionally the unit is quite simple and follows closely the technique used for the units already described. The same panel and box shield are used as for the Control Unit No. 6. Only one of the valve mounting brackets will be required because there is only one valve. The bracket is mounted between the volume control and the bass control.

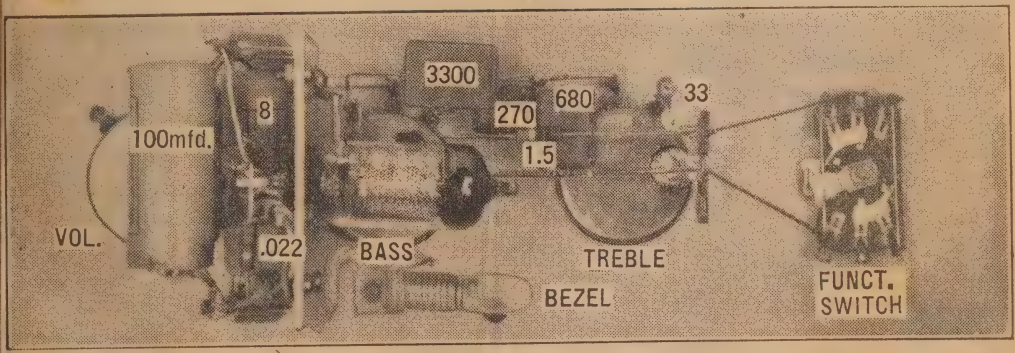
Starting with the function switch, the other controls in order are treble control, bass control and volume control.

Most of the components associated with the valve are mounted on the tag strips bolted to the mounting bracket, and a little diagram with this article shows how we connected them.

The layout isn't critical and it's not essential that it be exactly adhered to.

The filament circuit is not connected to the unit at any point, being earthed in the amplifier itself. As there is little danger of earth loops, earthed points may be made to any part of the mount or panel.

Note however that an earthing wire runs from the function switch



This top view completes the picture story. Note the panel light fitted for this picture.

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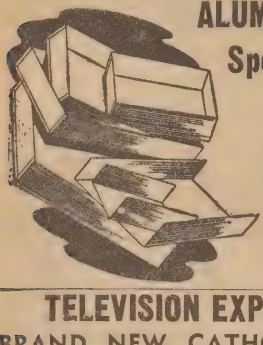

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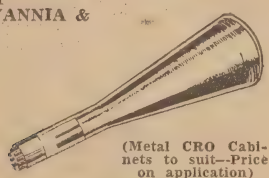

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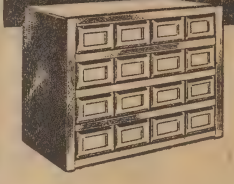

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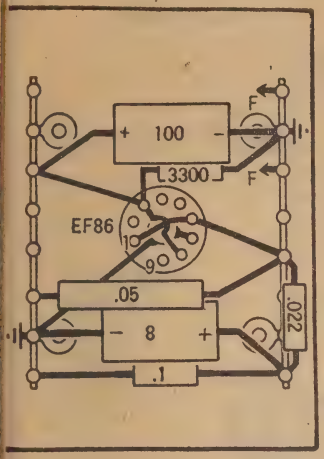
p to a three-tag strip soldered to he outside case of the treble con-rol (for convenience) and thence o the same mounting bolt to which he volume control is earthed. This rovides a direct earthing path be-ween these points just in case.

Various components in the com-ensation network are earthed



This diagram shows how we arranged various components on the valve mounting bracket.

irectly to this wire at convenient oints. The position of some com-onents is indicated on the photo-raphs.

The filament, high tension and arth leads to the unit are made to ppropriate points on the tag strips, nd connected to the sockets mount-ed at the rear of the shield box. The leads are first made to the ockets, of such length that they an be soldered to the tag strip as he unit is inserted in the box. There s no point in making these leads ny longer than is necessary.

The shield box is quite essential o avoid hum pick-up on the unit wiring. This is a high impedance ircuit and very susceptible to in-teraction with stray fields. With the shield in position, however, it is quite free from this trouble.

COUPLING LEAD

The input lead to the amplifier grid circuit should be made with low capacitance shielded cable or co-ax. as the impedance at this point is high enough for a long lead or high capacitance braid to bypass high frequencies. Two or three feet should be long enough, and all the wires connecting the amplifier to the unit may be run together through a protecting length of plastic tubing.

Any of the Playmaster tuners can be used with this unit. Note that when switching to pick-up or to tuner, the unwanted circuit is earthed to avoid any play-through effects, more particularly of course on radio.

As usual, a design for a front panel has been prepared to suit this unit and will be supplied to those of our advertisers who are interested in producing them.

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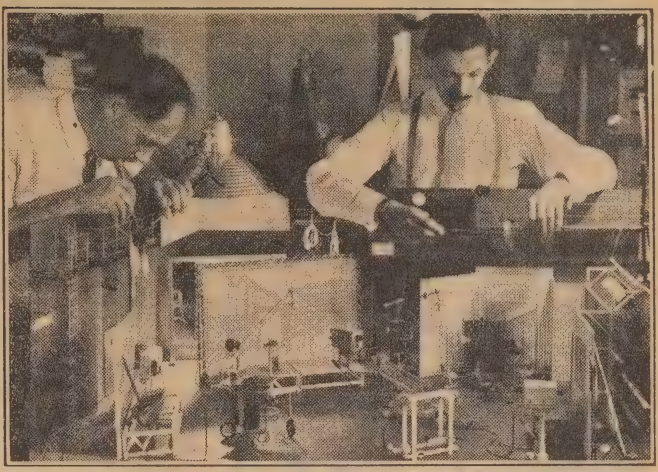

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FROM THE SERVICEMAN WHO TELLS

In marked contrast to last month's article, wherein we amused ourselves with stories of RF in audio amplifiers and butchered speakers, this month's stories bring us right back to the service bench with a bump. They are, in fact, the description of two very routine jobs.

WHILE neither presented problems which would unduly tax the imagination of the average serviceman, I have particularly selected them for two reasons.

For one thing they really are typical, and in this sense I am directing them to my younger readers who may have ideas of becoming a serviceman some day. They give quite a good idea of the average kind of job that has to be done in a service shop; the type of set which has to be handled every day and contains much more routine work than glamor.

I quote them just in case my stories of unusual faults and the exciting chase which goes on to track them down may have created the wrong impression; the impression that a serviceman spends his entire working life in a high-pressure battle of wits. Well, these two stories should serve to bring things into their proper perspective.

BATTLE OF WITS

The truth is that the exciting battle of wits is comparatively rare, the average job being, basically, routine checking and replacement. Of course, there is plenty of variety in the faults and in the types of sets and this in itself is a welcome safeguard against any suggestion of monotony.

But the fact remains that one must put in a lot of routine and often not very interesting work for every spectacular discovery of an unusual fault. Sometimes, as well as being uninteresting, they are downright frustrating. Provided this is appreciated, no one is likely to be disillusioned.

My second reason for recounting the stories is that both sets contained faults which I think reflect to the discredit of the manufacturer and are in line, to some extent, with readers' remarks recently published in these pages.

My first was a five-valve radiogram, not particularly old but definitely of the pre-microgroove, pre-miniature valve era. It was a little more elaborate than the usual five-valve chassis in that it boasted a 6L6 output valve and a 5V4 rectifier to power it. It carried the brand of a well-known maker.

MULTIPLE COMPLAINTS

The owner's complaints were (1) It picked up noise from an automatic electric iron, (2) it "mumbled" (the owners description, not mine), and (3) it had a broken dial cord. I gathered that this last trouble was the main reason for my assistance being sought. Presumably the first two faults had been tolerated for some time whereas the last one rendered the set inoperative.

Being a radiogram, I had to visit the owner's home and collect it. This also enabled me to observe the interference—and the "mumbling"—in its natural setting. This happened to be a dwelling behind a suburban shop.

By reaching into the back of the cabinet I was able to manipulate the dial drum and tune in a few stations. It was immediately obvious that the set was in a hopeless state of oscillation, even when a couple of the weaker local stations were tuned in. In fact the only way the weaker stations could be received was by tuning to zero beat and this provided the clue to the "mumbling".

Apparently this was the owner's term for the low frequency growls which occurred when the frequency of the set's oscillations drifted slightly and set up a beat note.

The condition was aggravated by the very small and inefficient aerial attached to the set. This was simply a length of wire strung under an iron roof at the rear of the dwelling and in close proximity to sundry machines, neon signs, &c., as found in a typical shopping area.

LOW PICKUP

With such low signal pickup it was also not surprising that interference from the automatic iron and similar domestic appliances was objectionably strong.

These facts having been established I set about getting the chassis out of the cabinet. It was mounted vertically and the only way it could be removed was to first remove the dial panel in the top of the cabinet. But the screws holding this were hard against the sides and back, so that I had to unscrew the lid stays before I could get the lid back far enough to allow a screwdriver to work on the rear screws.

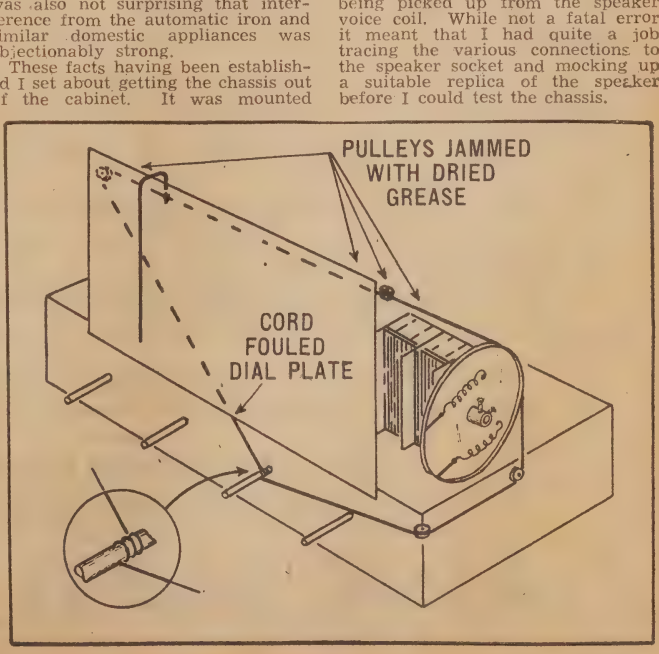
Then I had to disconnect various leads and cables relating to power, speaker, pickup, &c., finally reaching the stage where I could lift the chassis free.

SPEAKER PROBLEM

Normally I like to take a set's own speaker with me, but a glance at this installation discouraged me. For one thing the speaker transformer was mounted on the baffle board alongside the speaker.

Removing the baffle with speaker and transformer would have been awkward and removing the transformer and speaker separately would have involved setting up a soldering iron and undoing the leads. The connection would have had to be noted, of course, and restored when the set was finished. I didn't fancy either course and decided that this was one case where the universal bench speaker would earn its keep.

What I didn't realise at the time was that the speaker system was part of the feedback network, the voltage being picked up from the speaker voice coil. While not a fatal error it meant that I had quite a job tracing the various connections to the speaker socket and mocking up a suitable replica of the speaker before I could test the chassis.



Right—illustrating some points about dial movements as discussed here.

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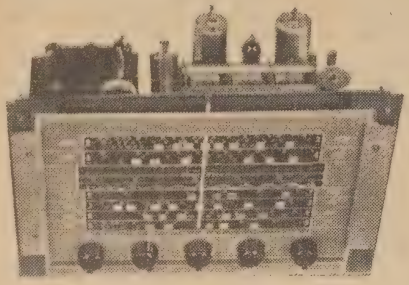

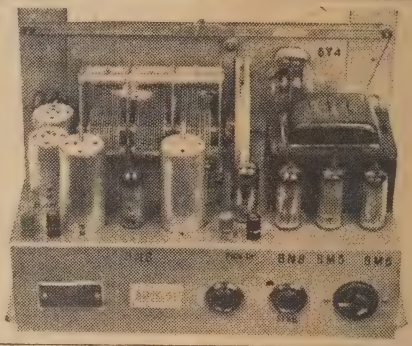

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While it doesn't sound much on paper it can give rise to some dark mutterings, as it did on this occasion.

First I tackled the oscillation. This was still very bad even on a better aerial and obviously due to a major defect. It didn't take me long to track it down. The valve shields used were of the form fitting variety and they were earthed by means of flexible braids soldered to the shell and running through the chassis to the main earthing system underneath.

BROKEN BRAID

In the case of the 6B8 the braid was broken and the valve had no effective shielding. Apparently some heavy-handed character who had previously serviced the set had heaved the valve from its socket without dissembling the shield so that the braid had been snapped. No one had considered it worth while to replace it, hence the violent oscillation.

Although the violent oscillation ceased when I fitted a new braid, the set was still right on the verge of instability. While this would not prevent proper reception of the local stations it could be objectionable on very weak signals and is the kind of thing which one tries to avoid on principle. I could well imagine the set "spilling over", for example, with high line voltage.

But though I checked every likely component in the set and tried every trick I know—and I've learnt a few over the years—nothing that I tried was of any use. I just couldn't make it once and for all stable.

While I hate passing the buck I was finally forced to the conclusion that it was simply the nature of the set and that the designer had cut things a little too fine in the compromise between sensitivity and stability. This being so, I considered I was justified in increasing the 6U7 cathode resistor from 300 to 500 ohms. This was quite enough to make it a completely stable set.

Next I tackled the dial, and not without some trepidation. It was one of those gloriously complex arrangements at which every serviceman shudders on sight. The gang was mounted parallel to the front of the chassis, with the drum at right angles to the dial. Conveying the drive from the tuning knob to the dial and drum involved more than the average length of cord.

NO STICKER

To make matters worse, the usual stringing sticker on the back of the chassis had long since vanished and, as I had never tackled this particular type before, I was really on my own.

Before actually starting the restringing I tackled the various mechanical movements associated with the dial, and which I suspected had probably contributed to the failure of the cord. These were mainly the pointer slide and the various pulleys, all of which were hopelessly gummed up with congealed grease and the inevitable layer of fluff which collects on every chassis.

As I have remarked in these columns before, I can never agree with the general practice of applying liberal quantities of oil and grease to these parts. The result is always the same. The grease invariably hardens, jamming the pulleys and impeding the pointer movement, thus throwing extra strain on the dial cord and hastening its failure.

It seems a far better proposition if the various parts are allowed to run without lubrication of any kind. After all, they are not running at high speed and the amount of wear over the lifetime of the set would be negligible.

Most mechanisms will run quite smoothly without copious lubrication and those which won't are probably examples of poor design, anyway. The person who designed and built them should retire to a corner of his laboratory and start all over again.

But to return to this particular dial. Having cleaned and freed the various movements I set about analysing the system and working out the correct path for the cord. In general terms this wasn't particularly difficult and I soon worked out a scheme which seemed to avoid such elementary pitfalls as having the knob rotate in an obviously reverse direction or bringing in 2SM on 2FC's calibration and vice versa.

One point that worried me though, was how many turns to take around the main drive shaft. On the one hand there were so many pulleys and turns involved that it was obvious that the cord would need to have a good grip on the shaft. On the other there was no groove in the shaft to keep the loops in place and it was obvious they would "walk" from front to back as the shaft turned.

Since there wasn't a great deal of room I obviously had to select enough turns to get a good grip, yet not so many as to cause the whole assembly to bind at extreme ends of the dial.

RESTRINGING

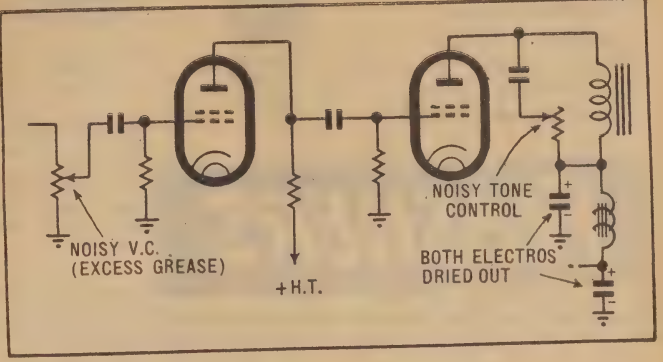
After due consideration I decided to take a chance on two turns around the shaft, and set to work. I can recall many dials that were easier than this one. The normal problems of trying to keep the cord in all the pulley grooves at the same time, while fastening the ends to the drum and tension spring, were aggravated by the fact that system required over 4ft of cord.

(Where have I heard a similar comment recently?)

Finally, with many unkind remarks about the designer, I managed to get everything in place and tightened up. There was only one snag; I had miscalulated the number of turns required to provide sufficient grip. No amount of wangling with the pulleys, slider, &c., would give me completely reliable operation right over the band.

There was only one thing for it, pull it down and add another turn. This I did, running into much the same strife as before. However, I was gratified to find that the extra turn was sufficient; the thing worked quite positively.

I tuned up and down the band and checked for any other snags. And I found one. One section of the cord running to the tuning shaft approached it from a top corner of the dial plate, meaning that it lay across the plate at an angle of approximately 45 degrees. I had wound the cord around the dial in such a fashion that this part was at the front of the three loops.



Multiple faults made this set unsatisfactory.

As I tuned toward one end of the dial the loops "walked" toward the tuning knob and eventually brought the dial cord against the lower edge of the metal dial plate, where it rubbed merrily as I turned the knob back and forth. It was obvious that no cord would stand much of that.

It was also obvious—now—that I should have arranged the loops the other way around, so that the offending cord would have formed the rear loops instead of the front one. This would allow enough—though only just enough—clearance to avoid the complication.

YET AGAIN

So, consoling myself as best I could, I undid the whole assembly once more, reversed the order of the loops, and strung it up again. I found I was getting quite good at it by this time.

I checked it over carefully and could find nothing wrong, so I set about a routine alignment check. This passed off without any complications and I considered the job as good as finished. Purely as an afterthought (and to provide a little music while I worked) I left the set playing on the bench.

Imagine my surprise when I looked at the dial a little later and noticed that the pointer, which I was sure I had left exactly on calibration, was now something like half an inch to the left of it.

More careful checking soon revealed the cause. The tension re-

quired to pull the gang around, via all the pulleys, was quite considerable and was apparently stretching the cord. When left alone this stretch took up, moving the pointer and, presumably, the tuning knob. Admittedly the type of cord I used was supposed to be suitable for radio dials but I imagine the manufacturers did not envisage it being used in 4ft 6in lengths.

As far as I could see I had only one hope left. I had on hand some nylon dial cord which was also described as free from stretch. I hadn't occasion to check this charteristic before, so I couldn't be sure that it would be any better than that I had used.

I could only try it and see.

AND AGAIN!

Which meant, of course, that I had to pull the whole thing down and restring it—for the fourth time. My only consolation was that I had done it enough times in a short period to have learnt all the tricks.

Fortunately, the nylon cord did the trick and the drift now appeared to be negligible. Which was just as well, because I don't think I could have faced another bout with the thing.

I don't know whether his Satanic Majesty has a special section of his domain set apart for the damnation of incompetent dial designers but, if he has, I can imagine no more appropriate punishment than to condemn the fiend to string one of his own dials with a special cord—designed to snap as soon as the job is completed. This process to be repeated until the end of time.

Returning the set to the owner I was able to demonstrate that the general performance was very much better and that there should be no further trouble due to "mumbling". But I pointed out that it was asking a lot of any set to expect it to work well on the aerial provided. In particular, I explained, it made the interference from the iron and other appliances just that much harder to cure.

For a start, therefore, I suggested that a better aerial and a good earth be tried and the owner intimated that he could probably rig up something himself. If this failed I suggested a line filter, but I felt that this would probably not be necessary.

And so I left the owner to rig his aerial, check the interference, and let me know the result. I've a feeling it will be favorable.

PLENTY OF TROUBLE

The next case, which did in fact follow hard on the heels of the previous one, was also a five-valve set, rather more pretentious than average and which was also minus its speaker. This time because the owner delivered the chassis to the shop and simply omitted to bring the speaker.

The owner listed four complaints: it hummed, it made strange noises, the volume control was rough, and it had a faulty tone control. Which, I imagine, is quite enough for one set at a time.

Having no speaker I was forced to set up the bench speaker again, and again I encountered a voice coil feedback system. It seemed to be my unlucky day.

Having traced the connections and mocked up a speaker, I switched it on. There was no doubt about the hum, it was quite bad. It presented no problem, being quite obviously due to electrolytics that had seen better days. A couple of new ones quickly silenced it and I turned my attention to the other faults.

The strange noises were not immediately obvious so I checked the volume control. There was no doubt about this either, it was absolutely atrocious. I pulled it out and was about to discard it and fit a new one when I decided that a control as noisy as all that was worth investigating. So I pulled the cover off and had a look inside.

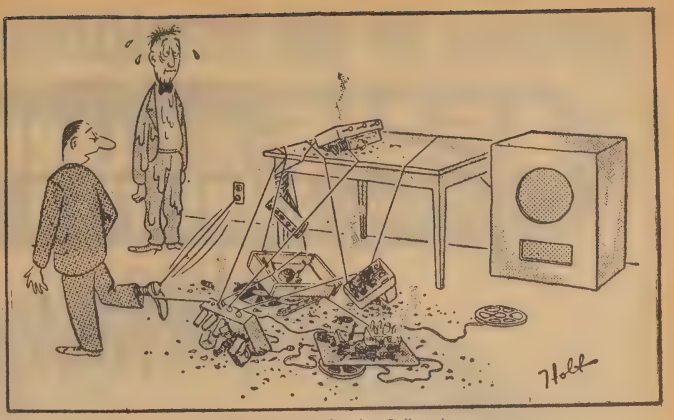
And what a sight met my gaze. The inside was liberally plastered with a brown looking grease and, while it is quite normal for the makers to lubricate these devices, I imagine the operator must have ladled the grease into this one with a teaspoon!

GREASE EVERYWHERE

Not only was it gumming up the sliding contact to the moving arm but there were also smears of it on the element. No wonder it was noisy! I decided that it could well be that there was nothing more wrong with it than this and that it might be worth trying to salvage it. In my case it would be an interesting experiment.

Accordingly I set to with some petrol and an old toothbrush and cleaned out the mess of brown goo. I probably removed some that should have been left there but there was little I could do to avoid this. With the worst removed I rinsed it in fresh petrol to remove the last traces, particularly from the element where small patches might be hard to detect.

Then I wired it back into the set and tried it. It was as silent as the grave, the element apparently being in perfect condition. This being so I decided that there was little point in charging the customer for a new one. Admittedly I had spent a few minutes cleaning it, but this was small compared with the price of a new control.



"Oops! Sorry! (Radio Bulletin).

Next the tone control. This appeared to have been the victim of some heavy handed user who wanted more treble cut than the system was designed to give; so he had just kept on turning. The result was a broken stop inside the control and mutilation of the "innards". There was no suggestion of salvage here, I dropped it in the waste bin and reached for a new one.

This fitted, I began to wonder what might be the story behind the strange noise the owner had mentioned. Was there really something else wrong with the set or were these noises merely the combined effort of the volume and tone controls? I decided that this latter could well be the explanation and that, if it did not show up in a reasonable time, I could only return it to the owner with the explanation that I had been unable to observe the complaint.

DIAL LAMPS

In the meantime I set to work on the dial lights. The owner hadn't mentioned them but they were all inoperative. There were five in all, some illuminating the dial proper and the others mainly serving fancy little "whatsits" on the dial to indicate broadcast or short wave, bass-treble, bandspreads, &c.

While this was all very well, I felt that the designer might have more profitably devoted his energies to devising a more satisfactory method of mounting the dial lamps. In a chassis which had obviously been designed for an expensive set the method employed was woefully shoddy.

The lamp and socket assembly was held in the usual rubber holder and forced under a three sided metal channel fitted to the top and two sides of the dial assembly. The channel was bolted to the metal back plate of the dial and extended across the space between it and the dial glass, eventually finishing up in front of the glass.

In this respect there was nothing very unusual about the arrangement. Where it failed was in the fact that the channels did not extend to the ends of their respective sides, thus locating the lamp assembly where it could very easily short to the metal back plate. Also, by the

(Continued on Page 127)

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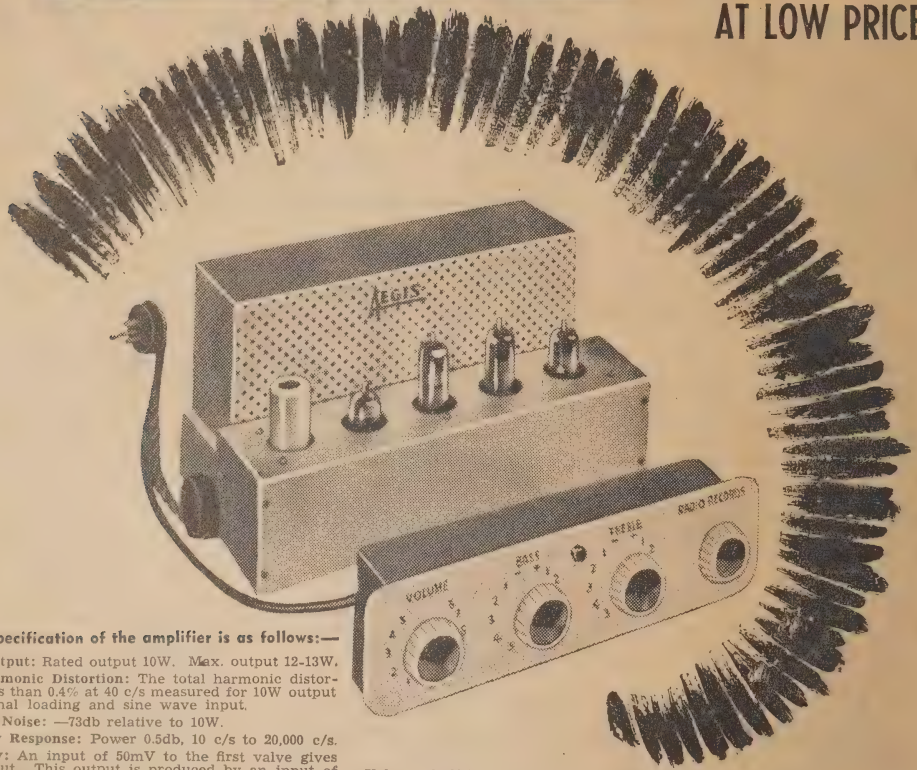

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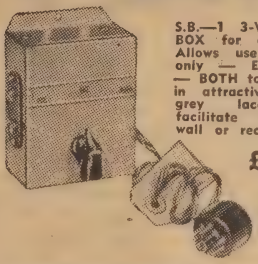

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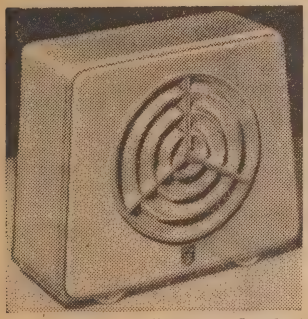

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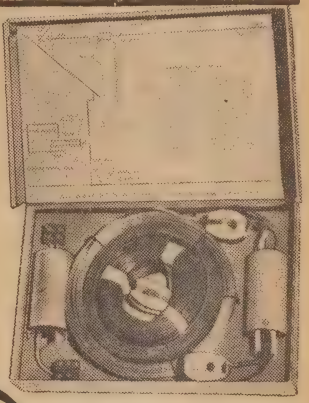

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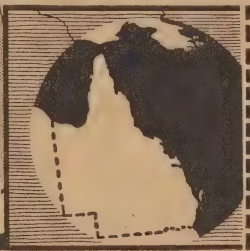

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Here's your answer, Tom!

Although the science of electronics is expanding from day to day, bringing with it new developments, new words and new expressions, it is wise not to forget about older things. At least Tom seems to think so, judging by the questions he has put forward this month.

VOLUME expanders, dial lamps and transmitters appear on this month's "menu".

What is a volume expander? Is it just another kind of amplifier? How does it work and what is it used for?

Uninitiated people, like yourself, Tom, are often mislead into thinking that a volume expander simply provides higher volume from records than would otherwise be possible. In point of fact, it does nothing of the kind.

". . . plenty of strife as it is . . ."

The device does not produce any acoustic output of its own, but controls the output from an amplifier. Usually it is an integral part of the amplifier.

Its purpose is to make pianissimos sound softer and fortissimos sound louder in music played from gramophone records. Putting it into other words, it expands the dynamic range of recorded music.

Particularly on older records the dynamic range was deliberately restricted, in order to keep soft passages above the noise level and allow loud passages to be recorded at a reasonable amplitude. Needless to say such recordings lacked the contrast and volume range the composer intended them to have.

So a "volume expander" was sometimes used to restore the dynamic range as much as possible.

The basic principle of volume expansion is quite simple. Part of the input voltage of an amplifier is sidetracked and used to control the output from the amplifier.

In practical circuits the sidetracked signal is amplified separately, fed to a detector and rectified to provide a DC voltage which varies with the signal level.

This varying DC voltage is used to control the grid bias of one or more variable-mu valves in the amplifier proper.

Initially, these valves have a very high negative bias, keeping their amplification down. The DC from the volume expander, on the other hand, is of opposite polarity, and, if applied to the grid, tends to reduce the bias, making the stage more sensitive.

The higher the original signal level the higher the sensitivity of the amplifier becomes. The net effect of this is that strong signals are amplified much more than weak signals, and the difference in level made larger.

This means that the dynamic range of the amplifier is extended.

This action takes place, no matter what the setting of the volume control. The average level of the sound is quite immaterial.

Present day EP and microgroove recordings have a far greater dynamic range than earlier standard records so that volume expanders are now largely outmoded, except perhaps for listening to vintage recordings.

WIFE TROUBLE

In any case, Tom, volume expanders have never been very popular with we married fellows; we run into plenty of strife as it is trying to convince our wives that an orchestral record needs to be played at something like the original volume for best results. Add a volume expander and we'd never hear the last of it!

And so for the next one.

Why is it necessary to make transmitter coils of copper tubing or rod? Would ordinary wire not be good enough?

The conductor size used in the construction of transmitter coils depends entirely on the current carrying capacity of the conductor and the maximum current expected to occur in the circuit.

Usually, the highest currents occur in the tank circuit of the final power amplifier and it is particularly here that heavy copper conductors are used for the coils.

The solution to the problem lies in a little equation:

$$P = I^2R$$

Where P is the power in watts, I the current in amps and R the resistance in ohms.

Now, whenever current flows through a conductor, there will be some power lost in it due to the ohmic resistance of the conductor. This is very handy if one wants to generate heat, but hardly useful when one wants to feed all the available power to the aerial, to be radiated into space, as is the case with a transmitter.

A closer look at the formula reveals that the power dissipated in a resistance increases with the square of the current.

It may seem, according to the formula, that a resistance of fractions of ohms would make very little difference when there is usually much less than an amp of DC plate current flowing in the coil. What is more the plate current only flows for a comparatively small part of a cycle, as most RF power amplifiers operate under class C conditions.

The trouble is that besides DC current there is a much larger RF current flowing in the tank circuit, usually called the circulating current.

This circulating current will be quite a few amperes, even in a

"End-on view of a conductor!"

modest 100 watt transmitter. It is quite sufficient to heat appreciably a tank coil wound with 18 g. wire.

When the power output of a transmitter is calculated in kilowatts, this circulating current skyrockets and with it the resistance losses in the coil, unless steps are taken to reduce the resistance.

Add to this the fact that the RF resistance of a conductor may be many times the DC resistance of a conductor, owing to skin effect (RF current flows only on the surface of the conductor) and you will soon realise, that a conductor of ex-

tremely low resistance is required for such applications.

And just what causes this "skin effect?" Well, Tom, it is a by-product (if we may use the term) of the self inductance of the wire. As you probably know, even a straight wire has inductance, even though the effect is much less than when it is wound into a coil.

The inductance itself is probably not hard to visualise, being simply a product of the magnetic lines of force which surround the wire, expanding and collapsing as the current rises and falls. As with any inductive effect, the result is to generate a counter EMF which opposes the applied EMF.

So far all is plain sailing, but we have yet to explain the skin effect. This is due to the fact that those magnetic lines which are generated at the centre of the wire must cut all the conductor as they expand and collapse. Those generated closer to the outside cut only a portion of the conductor and those generated right at the surface would not cut it at all.

STRONGER FIELD

Thus there are much stronger magnetic forces at work in the centre of the wire than at the outside, making it a lot easier for the current to travel closer to the surface. This effect becomes more pronounced as the frequency increases and, at very high frequencies, there is so little of the centre of the conductor used that tubing is just as efficient as solid wire of the same diameter.

In an effort to illustrate the effect, Tom, we asked our artist to draw an end-on view of a conductor. Unfortunately he seemed to get the wrong idea!

Even at broadcast frequencies the effect is quite marked and has led to the use of stranded (Litz) wire in place of solid wire for virtually all coils used today. By using several strands of very fine wire in place of one heavier one the effective surface area is increased, reducing the resistance at radio frequencies.

As "skin effect" resistance increases with rising frequency, copper is adequate for broadcast and the lower short wave frequencies, but silver plated copper is preferred for VHF and UHF, to reduce further the resistance of the surface.

There are too many variables involved in the calculations for inclusion in this article, but foregoing will illustrate adequately the need for large conductors in transmitter coils.

While we are on the subject of transmitters, here is another question, which concerns not big, but small transmitters.

Some years ago I saw a little set advertised, for playing records through a radio set with out having wire connections between the receiver and the pickup. Could I build such a unit?

A unit for such a purpose could indeed be built, Tom. They have even been produced commercially at one time, but we would definitely advise against it.

You see, Tom, such a unit, if not connected to the set by wires, would necessarily have to be a "wireless", and that is the nigger in the woodpile.

It would have to be a transmitter, to which the pickup is connected. The music from the record would then be broadcast, and picked up by any normal receiver, if tuned to the frequency of the transmitter.

The trouble is that it may not only be picked up by your own receiver, but by others in the immediate vicinity. And before you knew where you were, you might have the wireless inspector on to you.

As you probably know, to cause a radio interference is an offence against the law, involving possibly a fine and confiscation of equipment.

That would make the playing of records rather expensive, Tom.

Commercial units of yesteryear operated at the extreme end of the broadcast band, and the receiver to be used with it had to be able to cover this frequency.

So, take our tip, Tom, and "stay off the air".

In any case, the reproduction is likely to be better with the pickup fed directly into the audio system. It avoids the complications and distortions of impressing the signal on an RF carrier, then passing it through the receiver's tuning system and detector—all needlessly!

I have a circuit, in which the dial lamps are shown to be connected to the 5V winding of the transformer. No matter how hard I have tried, though, I could not get any 5V dial lamps, Could I use ordinary 6V dial lamps?

Within certain limitations the answer is Yes, Tom. Normally a 6.3 V dial lamp will work quite effectively from a 5V supply. After all, they are only required to illuminate the dial scale, and not double as a reading lamp as well.

At the same time there is less strain placed on the lamp filament on the lower voltage, thus extending the life of the lamp and preventing blackening of the glass bulb.

So there you are. It is actually of an advantage to run dial lights at lower than rated voltage.

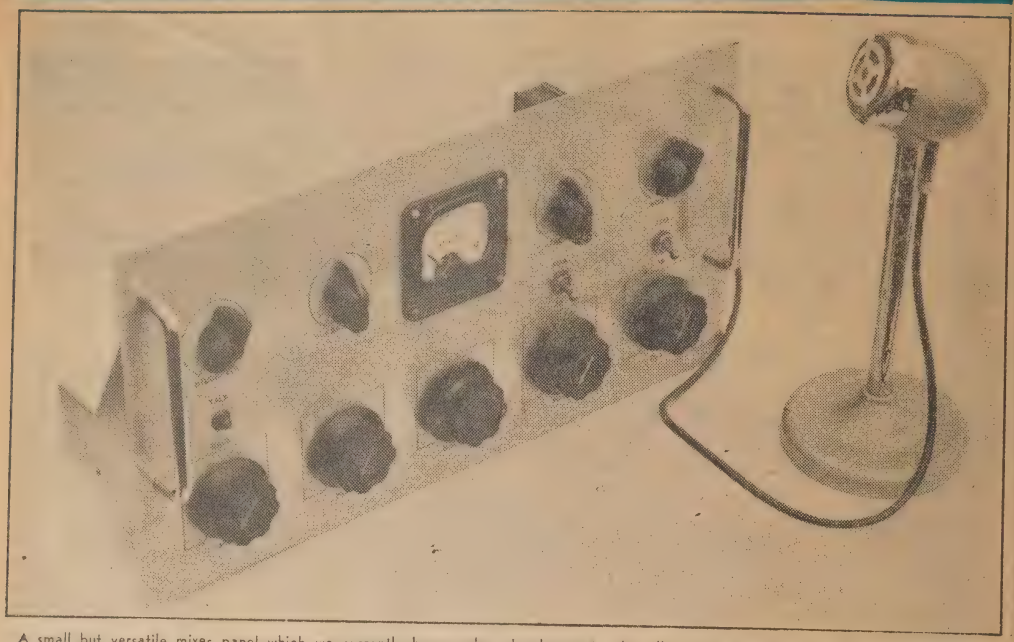
BE CAREFUL

It is not all plain sailing, though. Normally, the 5 V winding on transformers is provided for directly heated rectifiers or rectifiers in which the cathode is tied to the filament. The rectifier filament or cathode being anything up to 400 volts above chassis potential, connecting dial lights to the transformer winding would place these also on the same potential, making them extremely inconvenient, if not dangerous.

Dial lamp sockets are not provided with insulation sufficient for such voltages and may easily break down. Also, being in an exposed position on the chasis, they are easily touched, when the set is removed from its cabinet. And 400 volts are nothing to play around with

So, for safety's sake, Tom, don't connect anything to the 5V transformer winding, unless you are sure it is unused.

If it is used, leave it strictly alone.



A small but versatile mixer panel which we currently have under development. It will accept the input from two microphones two pickups or two external channels. Full compensation facilities are built in, plus booth monitor, program monitor, level indicator, low impedance output, etc. The microphone in the picture is a crystal insert type which might, for example, be used for talk-back.

DESIGNING A MIXER UNIT

We have had many requests in recent months for information on preamplifiers and mixing systems. In this first article, we plan to discuss the whole subject, having in mind the techniques and components which apply for home-built equipment. Next month we anticipate being able to describe the mixing panel pictured above.

by Neville Williams

IN the professional broadcasting and recording field, the design of preamplifying and mixing systems has, of necessity, become a very exact science. Over the years, it has been the subject of numerous papers, articles and textbooks.

The microphones normally employed have very low orders of output signal, in the interests of fidelity, but this signal has to be amplified to usable levels without the listener being aware of any background noise or hum.

MIXING FACILITIES

At the same time, mixing facilities have to be provided, whereby the signals from several microphones can be combined and varied at will and finally fed into a single program channel.

For dramatic work, bridge music and sound effects may also have to be fed into the channel from disc and tape, requiring very elaborate "mixing" facilities. The relevant controls must be centralised, completely smooth in operation and completely silent.

Normal practice in broadcast and recording studios is to use microphones with an output impedance of between about 50 and 500 ohms. These are fed, through twin balanced and shielded lines, to centralised preamplifiers.

Pickups also are normally of the low impedance type, equalised as necessary and then likewise fed to preamplifier stages.

It is common practice to use telephone-type patching panels which allow alternate amplifier sections to be substituted in the case of a fault and which also allow various microphone, pickup and line circuits to be directed to different control consoles.

The control and mixing facilities often involve the use of low impedance stepped attenuators which, while rugged and reliable, are very expensive.

The associated valves are low-noise types, hand-picked for good characteristics and fed from remote power supplies and/or batteries.

TOO SPECIALISED

As can readily be imagined, this whole approach is completely beyond the means and the requirements of the average audio enthusiast.

He cannot afford the expensive array of lines and transformers which go with the low impedance techniques, nor can he think in terms of stepped attenuators.

He must be prepared to work, wherever possible, directly into grid circuits and use ordinary good qual-

ity potentiometers to provide volume control and mixing.

He must be prepared to use ordinary—and even disposals—type valves, running them from conventional AC supplies and taking what precautions he can against hum and noise.

And last but not least, his equipment must be of the type which he can carry away when its job is done.

It is for this type of reader that we present this article.

Nowadays, many applications are suggesting themselves for simple amplifier-cum-mixing facilities. You may recall that, in the October issue for 1954, we featured an amplifier intended for use by film and film-strip enthusiasts. There is a very definite tendency, these days, to "dress up" the presentation of home movies and film strips with a background of music and a spoken commentary through a microphone.

FOR RECORDING

Many have gone to the extent of pre-recording commentaries and music on tape, with the addition of sound effects and even limited dramatics. For such purposes a fairly versatile mixing system is essential.

The same would be true for synchronised sound or "striped" films.

Then again, for stage presentation and dramatic work, it is often desirable to use a number of microphones and pickups to feed the main PA system—calling once again for limited mixing facilities.

Additionally, many readers have come to light with special requirements. One such reader, having an apparent connection with a local dance band, wanted to make tape recordings with certain sections of the band, or the vocal accompaniment, accentuated to varying degrees. He wanted to use multiple microphones, with a separate fader on each one.

Another wanted equipment to train an amateur group so that they would be able to present short religious programs over the local country radio station. If the equipment was good enough to produce acceptable tapes directly, so much the better.

Such then are the requirements. How can they best be met?

Before we can answer this question properly, it is really necessary to examine the kind of microphones and pickups which non-professional folk have to use, the limitations of ordinary carbon volume controls, the tricks necessary to minimise noise and hum in ordinary preamplifier stages and so on.

VOLUME CONTROL

Strangely enough, the most appropriate point of entry into the whole subject is with the volume control and its most appropriate position in an amplifier circuit. Actually, the position of the volume control is so conventional that we sometimes lose sight of the fact that it is, in fact, fairly critical.

If the volume control is located too near the input of a high-gain amplifier, valve hiss and residual hum may be apparent to an annoying degree, even with the volume control turned right off.

There is also the danger that small discontinuities, which are inevitable in the resistance element, will produce an objectionable scraping noise when the control is operated.

Conversely, a control which is located too far from the input may not protect early valves from overload with strong input signals. Severe initial distortion can result from this effect, even though the rest of the amplifier is operating at quite low level.

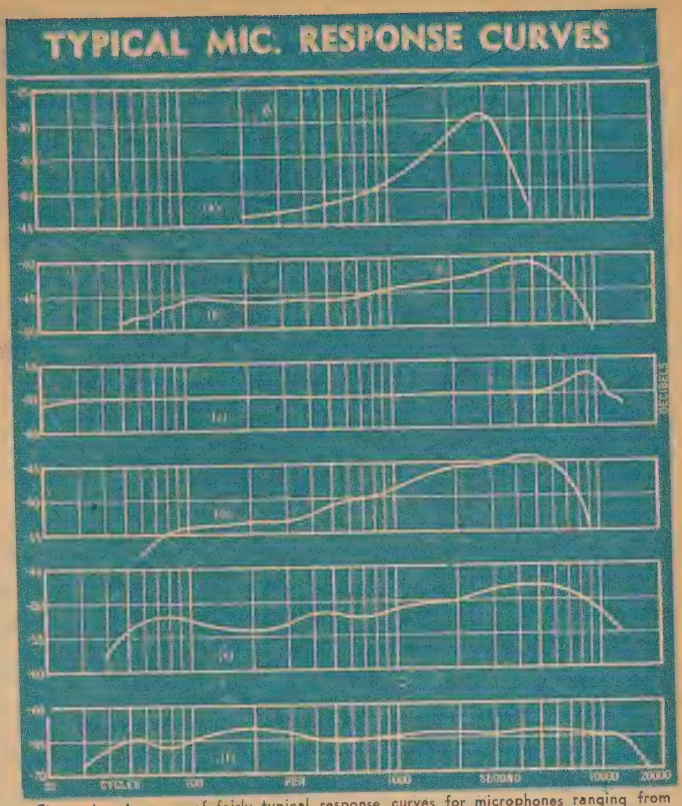


Figure 1: A group of fairly typical response curves for microphones ranging from cheap crystal inserts to medium-priced ribbons and dynamics. In general, the better the microphone in terms of response, the lower is the output voltage.

SIGNAL LEVEL

It is conventional practice, nowadays, to locate ordinary carbon volume controls at a point in the circuit where the input for full output is about 0.25 volt RMS.

The audio system in an ordinary receiver is commonly designed with about this order of sensitivity. The input grid is connected via the gain control to the radio tuner or crystal pickup as required and, since the output from both is normally well over 0.25 volt, there is usually gain to spare.

In more specialised equipment involving such things as magnetic pickups, photocells or microphones, the available signal may not be sufficient to drive an amplifier having the above mentioned order of sensitivity. At least one extra stage of amplification is necessary.

If the extra stage were wired into circuit AFTER the volume control, difficulties would be encountered as aforementioned with valve hiss, residual hum and control noise.

To avoid such troubles, it is normal practice to provide the extra stage BEFORE the volume control, with the reservation that the extra stage will never be called upon to handle an input signal large enough to produce overload and distortion in its plate circuit.

On the basis of this explanation, we can follow the conventional practice of referring to the stages after the volume control system as the "basic" amplifier. Stages ahead of the volume control system can be referred to as "preamplifiers".

PREAMPLIFIER

We can further state, by way of definition, that the purpose of a preamplifier is to raise small signal voltages to a level where they can be applied successfully to a volume control or, in fact, to a complete volume control cum mixing system.

The amount of gain required from a preamplifier stage depends naturally on the input signal from which it has to operate. If the input signal is very small, then the gain of the preamplifier stage (or stages) must be quite high to raise the level over the required quarter-volt or so.

Conversely, a higher input signal does not require as much preampli-

fication and the circuit problems are fewer.

The microphones, which are likely to be pressed into service by private individuals, would naturally constitute a varied array of current and obsolete types ranging from cheap crystal inserts to near-professional models ranging up to about £30.

To assess the merits and demerits of each and every likely type would be an impossible task, but certain general remarks can be made about frequency response and output. They should at least help to put readers on the right track.

Carbon type microphones can be ruled out immediately as quite useless by modern standards.

By far the most numerous—and the cheapest—microphones currently available are the crystal inserts which retail for something under £2 each. These are used very commonly and successfully in pageing systems, communication equipment, "Ham" shacks and so on—all of them "voice" applications where clarity is of utmost importance.

RESONANCE

However, their "clarity" invariably springs from a prominent diaphragm resonance in the middle of the range. It distorts the character of voice so much that the inserts are useless for more ambitious work, where it is normally desired to retain as much as possible of the natural timbre of the person's voice.

For music, of course, a peak in the range spoils the reproduction completely.

Curve (a) in figure 1 is fairly typical for this type of cartridge. It shows a 10db peak at about 3 Kc, falling away sharply above about 5 Kc. The bass response is also poor, so that it is not hard to understand why such inserts are often described as having a "crisp, metallic quality".

It is also not difficult to understand why they are very prone to acoustic feedback, when used anywhere near the loudspeaker or a public address system; or why the feedback is evident as a high-pitched howl. But for the presence of the peak, the amplifier gain could be advanced several db before feedback showed up.

The main advantage of such microphones is their relatively high output, as evidenced by their rating of about -40db below the usual reference of 1 watt-dyne per sq. cm. In actual fact, the output of the unit shown peaks to higher than -30db.

MODERATE GAIN

With an output of this order, only a very modest preamplifier is necessary to ensure ample overall gain. However, as we mentioned earlier, such units are intended for voice communication only, and are quite unsuitable for the more ambitious applications we have in mind.

The "wide-range" or "high fidelity" inserts—neither term being really appropriate—are a better proposition. Curve (b) is typical for such an insert, although some manufacturers claim a response somewhat flatter than this.

In broad terms, one can expect from such cartridges a useful response from about 40 to 7500 Kc, with a 2 to 4db rise somewhere in the middle of the range.

At the present time, these cartridges retail separately for something under £3 and are used, in one brand or another, in many of the complete microphones retailing around the £7 to £9 mark. Curve (b)—and the foregoing remarks—may therefore be regarded as broadly typical of all such microphones.

In practice, the majority of such units still sound somewhat "peaky" but are sufficiently natural for modest stage work, recording voice commentary and so on. They can only be recommended for musical recording on a limited scale.

In most cases, the wider range

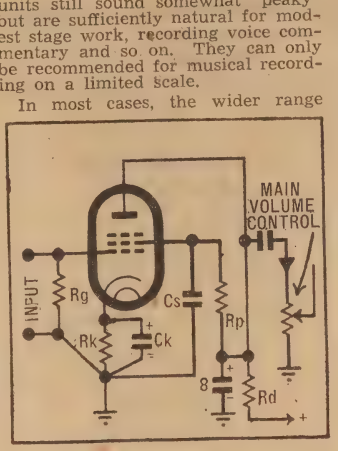


Fig. 2: A basic preamplifier circuit which is discussed in the following pages.

cartridges are basically similar to the high-output voice types, except that an acoustic filter in front of the diaphragm is used to damp the resonance peak. It also reduces the output by about 2:1, as is evident from the fact that curve (b) shows an average level of about —45db.

Rather more preamplifier gain is required, but still not more than can be provided by a fairly high-gain triode preamplifier.

HIGHER PRICE

From the diaphragm type crystal inserts (or complete mics.) the next step appears to be to the semi-professional sound-cell type crystals. These are capable of a much better order of performance, but retail for upward of £15, depending on their specifications.

From such microphones one can expect a response something like curve (c) and, while they are not widely used for serious professional work, they would be good enough to keep a private enthusiast happy for quite a long time. As with all crystal devices, however, they must be protected from extremes of temperature and humidity.

Curve (c) shows an output level of —59db, which is a good deal down on the diaphragm types previously mentioned. One would expect to follow such a microphone with a high-gain pentode preamplifier.

Coming to a different class of microphone, quite a number of inexpensive dynamic (moving coil) microphones have been sold on the local market. For the most part, these have been intended primarily for public address work, with high output and extreme ruggedness as their main virtues.

Curve (d) is fairly typical. It shows an 8db rise between 500 and 4500Kc, falling away below about 50cps and above about 6Kc. The output is shown as about —50db, so that a fairly high-gain preamplifier is desirable, usually a pentode.

In general, the same remarks would apply as for the cheaper crystal inserts: They give a crisp, metallic quality on speech but are too unnatural and too peaky for more serious work.

One can obtain better quality dynamic units, of course, but once again the price is likely to run to between £15 and £20. Curve (e) is typical enough for one of the better quality dynamics.

TO LINE OR GRID?

It is worth noting that dynamic microphones can usually be supplied with in-built output transformers intended to operate into lines of one impedance or another, or directly into grid circuits. The output voltage from the "line" types is quite low, unless it is stepped up, as intended, by a separate line-to-grid transformer.

Ribbon or "velocity" microphones make up the remaining group which needs to be mentioned. These range from inexpensive little units selling for a few pounds to high-quality professional types selling for anything between £30 and £100.

The latter can be dismissed as beyond the means of most private enthusiasts. We can also dismiss certain very small types, having the ribbon enclosed at the rear and intended for speech work only.

In between these extremes, a variety of ribbon types have been sold. The cheaper ones, though free from peaks, have usually lacked somewhat in treble response and output, due to limitations of the magnet structure and coupling transformer. The dearer ones—those approaching £20 in price—are generally better and equal any likely demands of a private enthusiast. Curve (f) is typical of what one can expect.

Because they should not be used "close-up" and because their output is low, anyway, ribbon microphones usually have to be followed by a high-gain preamplifier. At the very least, a high-gain pentode stage would be required, with preference for a two-stage preamplifier, if a margin of gain is to be available at all times.

TRANSFORMERS

Like the dynamic types, velocity microphones are produced with either "line" or "grid" type coupling transformers built in. The "grid" type is necessary if its output is to be fed directly to the input terminals of the preamplifier.

At this stage, one might logically include a discussion of pickups and their preamplifier requirements, if any. However, this whole subject has been examined most exhaustively in connection with control units, domestic amplifiers and such like, so that repetition here is unnecessary.

Perhaps it should be sufficient to

say that crystal pickups need no pre-amplification and no special compensation, being normally fed via a 0.5 meg. potentiometer to the input of the basic amplifier.

Magnetic pickups, on the other hand, do require a preamplifier stage, designed to give both gain and bass compensation. A high-gain triode is often sufficient, though the lower output magnetics require a pentode stage.

We shall have more to say about this particular subject when discussing the design of our complete mixer unit.

GAIN PROBLEMS

Because the inclusion of a preamplifier stage (or stages) automatically involves a much higher overall gain, difficulties are likely to be encountered, which do not occur to any great degree in lower gain audio systems. These difficulties include microphony, hum pickup, valve and circuit noise, and instability.

Microphony is the tendency for early valves in the amplifier to generate noise when they are subjected to mechanical shock. Vibration of the electrodes produces a sympathetic variation in plate current, which is amplified by succeeding stages just as if it were a signal.

Microphony is least serious in equipment which can be rigidly mounted, and is not disturbed during operation. It can be quite a problem, however, where strong impulses from the loudspeaker can reach the preamplifier or where it is mounted in a mixing console subject to jarring by the operator's movements.

Ordinary valves are often used in preamplifier stages, but there can be no guarantee that they will be non-microphonic in operation. It is always helpful if the best of several such valves can be selected for the position, or if a flexibly mounted socket can be employed.

The best precaution against microphony is undoubtedly to use, in the preamplifier stage, one or other of the currently available "low-noise" valves, especially intended for the purpose. These include the Z79, EF86, 6BR7, &c.

All these valves are pentodes and give the highest gain when so connected. However, by strapping screen to plate, they can be used as low-noise triodes, giving medium stage gain in cases where this is adequate.

The use of a low-noise valve usually guarantees freedom from microphony troubles except in the most difficult applications. Flexible socket mountings are not normally required.

SHIELDING

Hum injection is another likely problem which needs specially to be considered.

As an initial precaution, the input circuit and leads to a preamplifier must be completely shielded to avoid pickup of hum voltages by capacitive coupling to AC wiring. The same shielding will be effective also against instability due to input-output coupling.

For the same reason, a shielded plug and socket is much to be preferred for a microphone connection to open terminals or an unshielded earphone-type jack.

Hum, which is due to eddy currents in the chassis, cannot be eliminated by mere shielding, because the eddy currents create minute hum voltages along the chassis and earth wiring itself.

At the very least, the "earthy" side of the signal input circuit, the cathode circuit return and the screen bypass (if any) should be made to one point only on the metal chassis. This will minimise the injection of hum voltages into the first stage (See figure 2).

SEPARATE CHASSIS

In actual fact, where low hum level is required and a lot of low-level audio circuitry is involved, it is most unwise to mount the preamplifier stage (or stages) on the same chassis as the power supply. Separating the low-level circuitry from the source of hum fields avoids the necessity for awkward single-point earthing techniques.

Now for a few words about preamplifier circuitry.

In the typical preamplifier circuit of figure 2, the resistor Rg would normally be selected to present a suitable load to the microphone (or other device) feeding into it. For crystal microphones it would most likely be 5 megohms, but could well be reduced to as low as 0.1 meg. for magnetic types.

If a variety of input devices is anticipated, requiring different loads, the wisest course is to make Rg equal to 5 megohms, which will suit most crystal microphones. Other microphones or devices which might, according to manufacturers' ratings, require a lower load, can then have a suitable additional load wired into the device or its input plug.

This additional resistor should be chosen such that, when connected in parallel with 5 megohms, it presents a net load of the required value. Since the 5 meg resistor is permanently in circuit, it ensures that the grid will not be left floating, even if no input device is connected to it.

The cathode resistor Rk will depend on the type of valve and its published operating conditions. However, the bypass Ck should be as high in value as practical and one of the new small 100 mfd. electrolytics is a good compromise between capacitance and size. A large cathode bypass is a good general precaution against hum injection from the heater-cathode circuit.

The heater circuit itself is important, but rather unpredictable. When using special low-noise preamplifier valves, it is usually sufficient to earth the heater circuit, either by an actual centre-tap in the heater winding or by way of a centre-tapped resistor across the winding.

POSITIVE RETURN

It occasionally happens, however, particularly with ordinary amplifier valves, that lowest hum is obtained when the heater return is made to a positive potential of up to about 20 volts. The idea of the positive heater return is to discourage emission effects and consequent current flow between heater and cathode.

SOME TYPICAL MIXING CIRCUITS

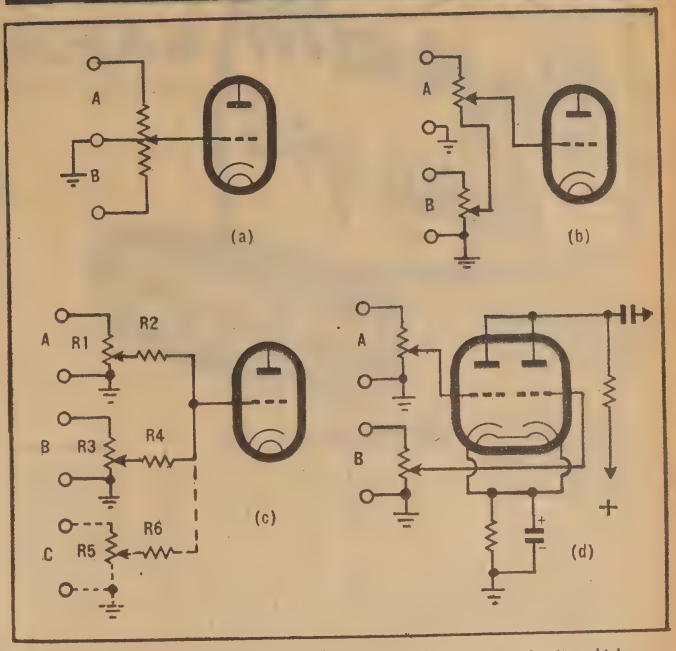


Fig. 3: Diagrams (b), (c) and (d) illustrate the basic mixer circuits which are commonly used in conventional audio equipment. A combination of methods (c) and (d) is often used where four or more channels have to be provided for.

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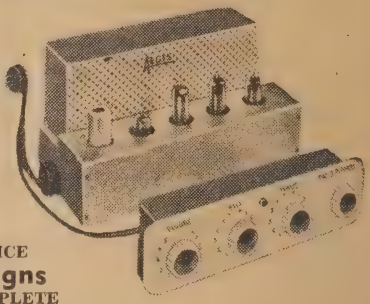

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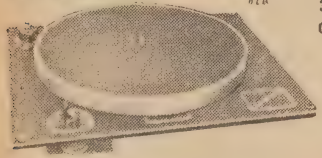

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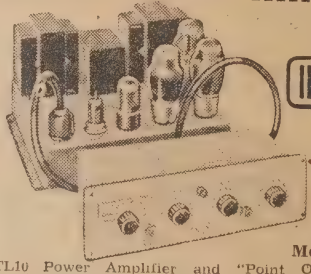

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The usual idea, where such a course is indicated, is to return the heater circuit to the cathode of an output valve—again quite a common practice in "Playmaster" type amplifiers.

In special cases, it may be found that lowest hum level is achieved by providing an earth or "earthy" return to a particular side of the heater circuit rather than the centre-tap. Even if it amounts to cancelling one hum component with another, it may be a worthwhile step.

Screen and plate circuits will normally be completed in accordance with recommended operating conditions for the particular valve. For pentode connection, the screen will be separately fed, and bypassed back to the common earth point for the stage, if trouble with eddy currents is anticipated.

TRIODE OPERATION

For triode connection, the screen will simply be tied to plate and not bypassed. If not connected internally to cathode, the suppressor grid may usually be tied to plate or to cathode, whichever is the more convenient.

Decoupling of the plate (and screen) circuit is almost invariably required and should be provided as a matter of course. Such decoupling will minimise filter hum problems, as well as feedback or "motorboating" troubles via the power supply.

Instability of this nature is seldom a problem, with a single preamplifier stage, but quite extensive decoupling is called for if the number of stages has to be multiplied to obtain higher gain or extra facilities. More will be said about this when we present the design for a complete mixer panel.

In conclusion, it may be appropriate to add a few general remarks about mixing circuits. Quite a few such circuits have been devised, but many of them are mainly applicable to low impedance techniques, involving lines, balanced transformers and stepped attenuators.

The circuits which are most likely to interest private enthusiasts are illustrated in figure 3.

Figure 3a shows an elementary arrangement which strictly isn't a mixing system, because it does not allow the content of both channels to be heard simultaneously. The centre of the potentiometer is earthed so that the central setting of the knob is "off". Rotating the knob toward one extreme or the other allows the content of channel "A" or channel "B" to be heard, as desired.

SPECIAL CONTROL

Success of the scheme depends on obtaining a potentiometer with a tapping at half rotation, which is also the electrical centre of the element. For smooth control from zero to maximum volume, the input to channels "A" and "B" should not be too high, since the action of the potentiometer will be restricted both by lack of taper and by the reduced rotation on either channel.

Figure 3b illustrates a series mixer which is useful in special cases only. The input to channel "A" should preferably be from a high impedance source as, for example, from the plate of a pentode preamplifier stage. The associated control might typically be a 0.5 meg. potentiometer.

Conversely, channel "B" and its associated potentiometer should be of fairly low impedance, otherwise channel "A" cannot be reduced to anything approaching zero volume unless channel "B" is also turned off.

Figure 3c is a much more useful circuit arrangement. It can accommodate several channels and there is no special restriction on the value of the individual gain controls. However, the isolating series resistors R2, R4, R6, &c., must all be of the same value and should preferably be no smaller in value than the largest of the controls R1, R3, R5.

Under these conditions, the maximum effect one control can have on the other is about 3db, but, in practice, it is always a lot less than this. For most purposes, the interaction of the controls can be regarded as imperceptible.

The series resistors introduce a loss into each channel, being about 6db for a two-channel circuit. The loss rises to 10db for a three-channel circuit and by about 2db for each additional channel.

This loss has to be made good by extra valve gain and may lead to ultimate difficulties if carried too far. Too much extra gain AFTER the volume control-mixing system may lead to high background noise.

The proper course is to see that the input to all channels is fairly high so that, even after the mixing circuit loss, only moderate gain is required. This may necessitate the use of separate preamplifiers in at least some of the channels.

TREBLE LOSSES

One point that must be watched is the possible deterioration in treble response due to Miller effect in the associated valve. Where R2, R4, and R6 are, say, 0.5 megohm, it is wise to use a pentode following the mixer. A high mu triode would be the least desirable type.

Figure 3d illustrates the well-known scheme of feeding inputs independently to the grids of two amplifier valves, the plates being connected in parallel.

Twin triodes are often used in this application, being quite satisfactory provided that the design does not call for a high output signal from the composite plate circuit.

Pentodes are better electrically than triodes in this application, because the mutual loading between the two valve sections is less and each can give higher gain and output than is possible with triodes. However, two valves would be called for.

The arrangements of figure 3c and 3d are often combined where four or more channels have to be accommodated. Two or three channels are mixed into each grid circuit and the output all four (or six) taken from the composite plate circuit. The valve gain may be controlled so that it just offsets the mixer loss.

Alternatively, the valve circuit may be allowed to provide whatever gain it will, but a "Master" control added to permit the overall mixer gain to be set to some convenient level.

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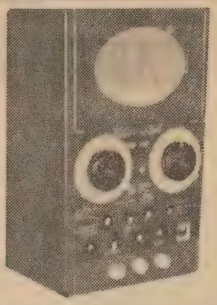

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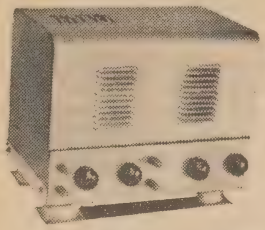

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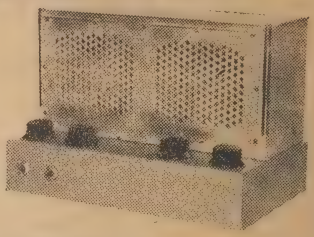

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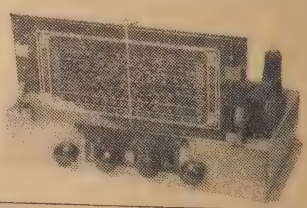

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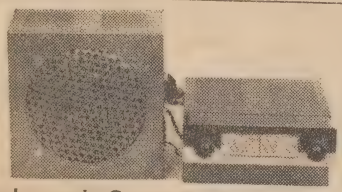

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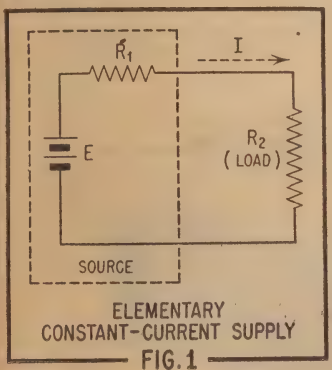
CONSTANT CURRENT SUPPLIES

Most workers are familiar with constant voltage power supplies, but many will be less familiar with power supplies deliberately designed to have exactly opposite characteristics. Of particular value in transistor circuits, the constant current supply is described in the following article reprinted from the Aerovox Research Worker.

IN most familiar vacuum-tube circuits, as well as straight electrical circuits, voltage is the independent variable. E-I tests of these circuits involve setting the voltage to predetermined levels and observing corresponding current values. Constant-voltage supplies, also known as "voltage-regulated supplies", are, therefore, desirable for operation of these circuits.

Modern electronics is becoming increasingly concerned with current-operated devices. Some of these are: semiconductor components, such as crystal diodes, rectifiers, transistors, thermistors, and non-linear resistors; saturable reactors; non-linear capacitors.



ELEMENTARY CONSTANT-CURRENT SUPPLY

FIG. 1

In many applications of these devices, satisfactory operation is obtained only by using constant-current power supplies. One case in particular (that of the point-contact transistor) is very important—the component can run itself to destruction when operated incorrectly from a constant-voltage supply!

Constant current in larger amounts is desirable in electroplating, solenoid operation, and instrument calibration.

Testing the E-I characteristics of current - operated components involves setting the current to predetermined levels and observing the resulting voltage drop across the component. This is the exact opposite of the technique used in checking voltage - actuated devices.

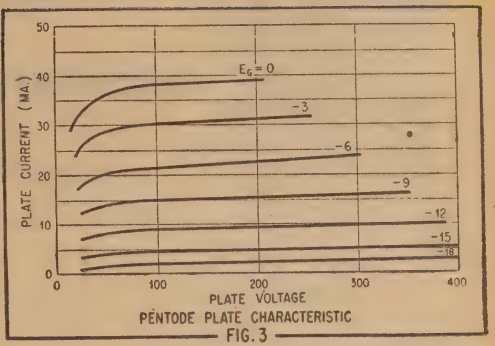
A power supply must have an effective low internal resistance in order to maintain a constant voltage at its output terminals under varying load conditions. This type of supply, the operation of which is characterised by stabilised voltage over a wide range of output-current variation, is now well known.

A constant-current supply on the other hand, is generally characterised by its appreciable internal resistance. Its terminal voltage is not constant, for the obvious reason that the voltage must adjust itself continuously, in order to maintain a stabilised current flow with variations of external loads.

From the foregoing descriptions and comparisons, it may be deduced that an elementary constant-current supply might consist simply of a voltage source connected in series with a limiting resistance—and this is true! However, both the voltage and the resistance must be large in most cases.

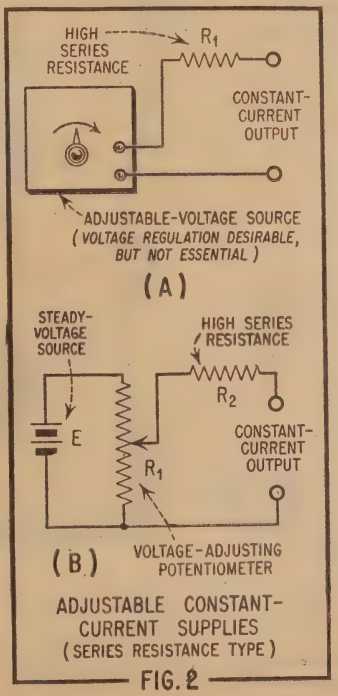
The following discussion will show why this is necessary:

Figure 1 shows an elementary constant-current system. Here; E is a voltage source, R1 a series resistance associated with this source (internal or external), and R2 a load resistance.



PENTODE PLATE CHARACTERISTIC

FIG. 3



ADJUSTABLE CONSTANT-CURRENT SUPPLIES (SERIES RESISTANCE TYPE)

FIG. 2

The components E and R1 have been enclosed within the dashed-line box to segregate them as the constant-current source, generator, or supply, although it is understood that R1 can be connected simply to voltage generator E as an external component.

SAME CURRENT

The same magnitude of current, I, flows through both R1 and R2, since this is a simple series circuit. Now; to return to the requirement that the series resistor be high-valued, Ohms' Law shows that a large value of R1 (with respect to the load resistance, R2) will have more influence in determining the value of I than will the value of R2.

Hence, the load resistance can undergo considerable fluctuation without materially changing the value of I, when the ratio of R1/R2 is sufficiently high.

An example will clarify this point. When R1 is 10 times R2, for instance, a 10 pc change in R2 causes less than 1 pc change in the circuit current. And a 100 pc change in R2 causes only an 8½ pc change in I. If R1 is 100 times R2 doubling the value of R2 produces only a 1 pc change in current.

Thus, the larger R1 is made, with respect to R2, the more constant the current will be maintained during large fluctuations of R2. However, increasing R1 to more favorable values means that voltage E must be increased proportionately, to produce the desired current value.

The required supply voltage, E equals I x (R1 plus RL); where E is in volts, I in amperes, and R1 and RL in ohms. Here RL is the resistance of the current-actuated load device and is identical with R2 in Figure 1.

A good rule of thumb often followed in laboratories is to make R1 at least 100 times R2 wherever practicable. It would, of course, be attractive to have R1 1000 times R2, but too high a limiting resistance

The SWISS have a word for it...

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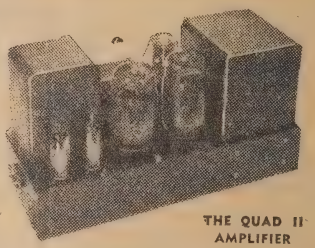

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entails use of a voltage so high as to be unwieldy.

It is important to note that a certain percentage change in supply voltage E can cause the same current change that would be produced by the same total change in circuit resistance. A quite large voltage change must occur for a significant current change when R1/R2 is high.

Nevertheless, in applications demanding the utmost in stability, voltage E should be supplied by a voltage-regulated source.

While a DC voltage source is shown, for simplicity, in Figure 1, this circuit is not limited to direct-current applications. An AC voltage source also may be employed if an AC constant-current system is desired.

Figure 2 shows two arrangements for adjusting the constant-current output. Both are series-resistance-type units and secure their adjustable feature through control of the supply voltage.

Figure 2 (A) shows the simple addition of a high series resistance to an adjustable-output AC or DC supply. In Figure 2 (B) the power source itself is not adjustable, so a voltage-setting potentiometer, R1, has been added externally.

While a battery is shown for simplicity, E can also be an AC source, such as the secondary of a power transformer. It also can be a power-line-operated DC power supply.

To Determine Required Voltage

(1) $E = I(R + mR)$

Where E is the required voltage,
I, the desired current,
R, the resistance of the load device,
m, the desired ratio of series resistance to load resistance.

mR = Value of the series resistance.

To Determine Maximum Series Resistance for Use with a Given Voltage

(2) $R_S = (E/I) - R_L$

Where E is the available voltage,
I, the desired current,
R_L, the resistance of the load device,
R_S, the maximum permissible series resistance.

To Determine Current Regulation

(3) $\%\ \text{Reg.} = 100\,\Delta I/(I_1)$

Where ΔI is the difference between the initial current value (I_1) and a final current value (I_2) resulting from a change in load resistance from an initial value (R_{L_1}) to a final value (R_{L_2})

$I_1 = E/(R_S + R_{L_1})$

$I_2 = E/(R_S + R_{L_2})$

Where R_S is the series limiting resistance, and R_L the load resistance.

These equations will be helpful in determining parameters required for constant-current supplies of the series-resistance type. In each case, E is in volts, I in amperes, and R in ohms.

The constant plate current characteristic of a pentode valve suggests utilisation of this characteristic to establish constant current in an external device. Adjustment of the DC control grid bias to various levels allows the selection of corresponding constant output-current values. In this way, the pentode valve can be used as a constant-current adaptor in conjunction with a DC voltage supply.

PENTODE CURVES

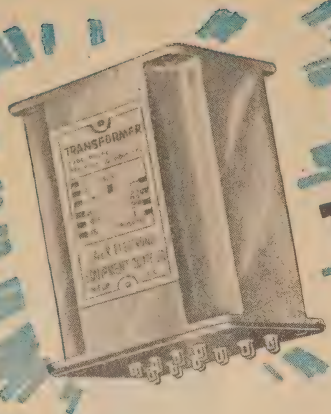
Figure 3 shows a typical family of Ep-Ip curves for a pentode. This family is plotted for seven values of control grid bias and are the characteristics of Type 6AK6 pentode operated at a screen potential of 180V. Note that each curve is nearly flat over a substantial portion of the plate voltage range and that the current level is reasonably constant.

A current-operated device connected into the pentode plate circuit would utilise this constant current. The resistance of the device might vary over rather wide limits, the lower limit of constant current being governed by the position of the lower bend in the curves.

Figure 4 is the basic circuit of a pentode-type current regulator. Plate and screen voltages are obtained from the DC source, E2. Control grid bias, adjusted by means of potentiometer R, is obtained from DC source E1. Some advantage will be obtained by voltage-regulating each of these voltage supplies.

The current-actuated load device is connected to the CONSTANT-CURRENT OUTPUT terminals. Settings of potentiometer R allow selection of desired output-current values, monitored by DC milliammeter M.

Many modifications of this basic arrangement are possible. A variety



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Prim.: 5000, 3000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 897 — 15 watts.
Prim.: 10,000, 8000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

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Prim.: 10,000 8000 ohms P.P.
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OUTPUT TYPE

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19% Screen Taps.

TYPE 949: 12 watts.
Prim.: 8000 ohms P.P. Sec., 2, 8, 12.5 and 15 ohms. Resp.: 10-50,000 cps. Valves: 6V6, 6BW6, KT61, EL84, etc.
19% Screen Taps.

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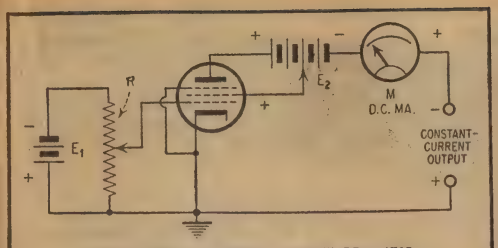
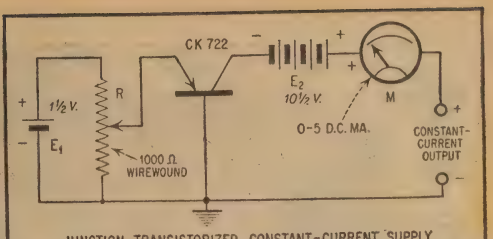


SIMPLE PENTODE CONSTANT-CURRENT REGULATOR

FIG. 4



JUNCTION-TRANSISTORIZED CONSTANT-CURRENT SUPPLY

FIG. 5

of pentode-type valves is available, and several may be connected in parallel for higher current output. Ingenious practical arrangements are possible to supply grid, screen and plate voltages from a common DC supply through a voltage divider system.

While batteries are shown for simplicity in Figure 4, power-line-operated voltage supplies are entirely feasible in this application.

SIMILAR SHAPE

Since the collector E-1 curves of a junction transistor closely resemble the plate curves of a pentode valve, the transistor may be used as a regulator at low current levels in a manner similar to application of the valve. Typical maximum operating levels are: Currents up to 10 mA and power dissipations up to 150 milliwatts, depending upon the type and manufacture of transistor.

Figure 5 shows the circuit of a simple miniature constant-current DC supply employing a Type CK722 PNP junction transistor and suitable for output currents up to 4.5 mA. The polarities shown are correct for the PNP type of junction transistor. If an NPN type is used, both battery polarities and the meter polarity must be reversed.

EMITTER BIAS

The emitter bias is derived from the 1½-volt cell, E1, and is set by means of potentiometer R. The collector is biased by the 10½-volt battery, E2. The constant collector current (the level of which is determined by the setting of R) flows through milliammeter M and the external, current-actuated load device.

This small-sized unit allows any selected output current level between 0.5 and 4.5 milliamperes to be maintained with excellent regulation in output loads between 15 and 1500 ohms.

Unlike the valve-type supply, the transistorised regulator can suffer from the pronounced temperature sensitivity of the transistor. However, in applications in which it is feasible and practicable to stabilise the ambient temperature, this scheme offers many attractions for stabilising low current levels.

When the external load is removed from any of the current regulator circuits shown in this article, the full supply voltage (or very nearly this value) appears at the output terminals.

The operator must keep this fact in mind, since the high terminal voltage is a probable source of damage to any high-resistance voltage-actuated device which might be connected to the constant-current terminals. It is also a source of electric shock, an important thing to remember when high supply voltages are employed.

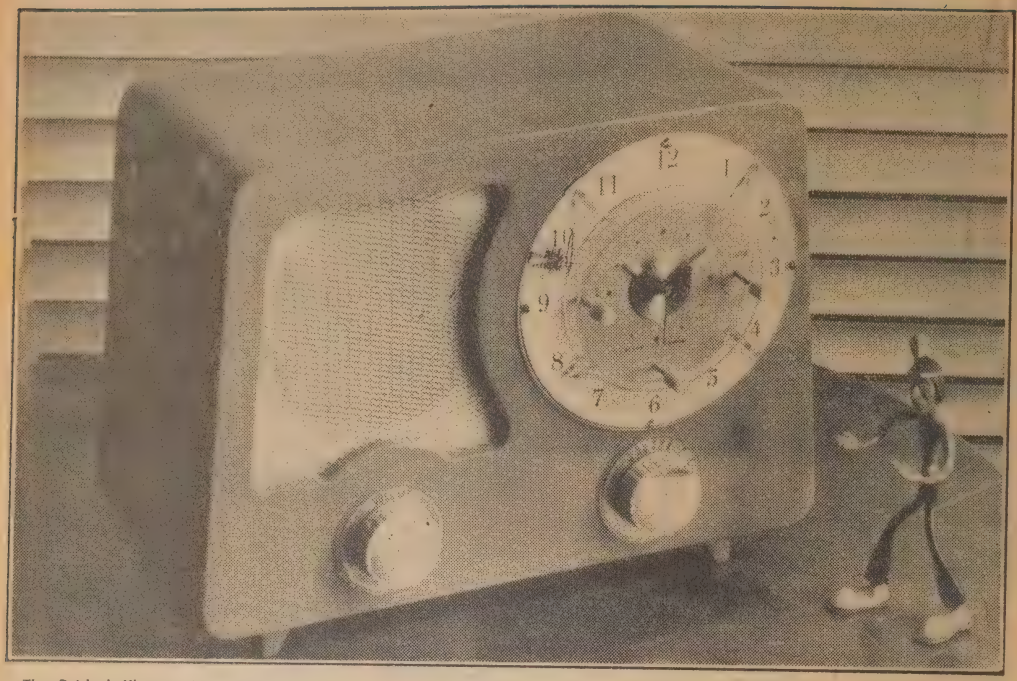
Sled hits 1280 mph

A ROCKET sled had reached a record of 1280 miles an hour, according to a US Navy scientist.

The scientist, Mr. W. Drinkwater, said the sled had achieved the speed at a Mojave Desert ordnance station.

Mr. Drinkwater said the Navy hoped to achieve even higher sled speeds soon.

The previous record for an unmanned sled was 1100 miles an hour at Edward Air Force base last year.



The finished Kloxette in a typical setting. This picture hardly does justice to the original, which was finished in bright red glossy lacquer. Other finishes will doubtless suggest themselves.

A 5-VALVE CLOCK RADIO SET

Our Kloxette, described in July this year, has already been acclaimed by suburban readers as one of our most attractive designs to date. Now we present it in a form which will appeal to readers in more remote areas and where it should prove just as popular.

by Philip Watson

THE Kloxette was originally intended as a conventional four-valve mantel set with the added feature of one of the now-popular in-built clock mechanisms, specially designed for such applications.

The idea behind these mechanisms, apart from telling the time, is a system of contacts which may be preset in various combinations and which are used to control the radio. As with an ordinary alarm system (which is also provided) the clock may be set to switch on the radio at any time during the following 12 hours. It may also be set to switch it off at any time within the following 60 minutes.

VERSATILE SET

Thus, as a bedside radio, it can be set to switch itself off after lulling you to sleep with soft music and also to wake you in the morning to something a little less raucous than a jangling alarm. However, if you don't respond to such gentle treatment, the alarm will take over in about ten minutes' time.

In the kitchen it will save the housewife the bother of watching the clock for the time of her favorite mid-morning serial, interior decoration session, or whatever happens to be popular at the moment.

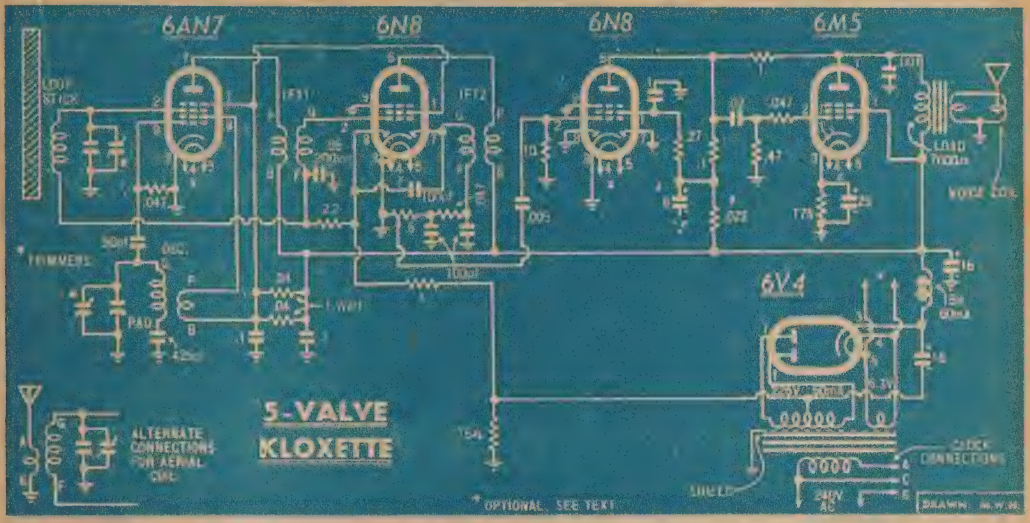
Truly a set for the lazy listener! When we had built the set, housed it in a cabinet of modern design, and added some decorative touches we realised that we had produced a likely winner. So in fact it proved to be. While there was nothing special about the set proper, its combination with the clock mechanism and an attractive cabinet gave it a very high appeal.

SIMPLE CABINET

At the same time the cabinet, while unusual in shape, was not beyond the scope of the home constructor. We have heard of many that have been made from our original specifications and a couple, at least, are worthy of special mention.

One reader finished his effort in glossy black lacquer, offsetting this with a gold anodised aluminium speaker grill to match the gold finish of the clock and dial scales. The result was something of which

CIRCUIT DIAGRAM OF 5-VALVE CLOCK RADIO SET



Apart from the valve only a handful of minor components are needed to add the extra stage to the original set. Note the HT decoupling circuit which should ensure freedom from hum under close listening conditions.

any commercial manufacturer would have been justly proud.

Another covered his cabinet with a veneer of blonde silky oak, made a first class job of it, and also finished up with a set which no one would suspect was home-made.

Doubtless many others have introduced similar original notes, though we still have a soft spot for the original, finished in bright glossy red with the speaker grill in its original color. It makes an attractive patch of color in any room.

So much, then, for the story of the set to date. But attractive and all though it may be, it is still only a four valve set and four valve sets have their limitations. They certainly do an excellent job in the city and nearby suburban areas and it is difficult to make a strong case for anything larger.

TOO SMALL

But a little farther out the lack of an audio stage begins to make itself felt and a four valve set is no longer a good proposition. To judge from our mail there are plenty of readers in these localities who would still like to build the Kloxette, but as a five valve version instead of the original. Again, a few have already built it and, while accepting its limitations, feel they would like to add an audio stage.

The latter group are in the happiest position, since they have done most of the hard work already and a handful of components and a couple of hours at the bench are all that is needed to make the conversion.

The first group would be well advised to study the original article in conjunction with this one, since it is impossible to repeat all the text presented on that occasion. (There are a few back copies still available if your files are incomplete.)

However, for their benefit, here are a few points about the original set. It is built on a chassis measuring 11in x 6in x 2 3-8in. You may purchase a blueprint through our query service and make your own from aluminium, or purchase it ready made in steel from your usual supplier. The latter course is usually the more satisfactory unless you have a particular reason for wanting to make your own.

To obtain a logical placement for the tuning and volume controls, the tuning gang is mounted underneath the chassis, supported on two small brackets. It is driven from the tuning knob through a planetary reduction drive to give the conventional vernier control.

The type of drive we selected is fitted on the front with a bush tapped to take three small cheese head screws to hold a pointer. We made a pointer from a scrap of perspex and used it in conjunction with a fairly large white tuning knob.

PARTS LIST

1 cabinet
1 chassis 11 x 6 x 2¾in.
1 power transformer 225 V 50 Ma.
1 60 Ma. choke.
1 electric clock movement.
1 5in loudspeaker with 7000 ohm transformer.
1 tuning capacitor, 2-gang, Min. MSP, or AWA or similar.
1 min. oscillator coil.
2 min. IF transformers.
1 rod aerial with brackets.
1 min. planetary drive.
5 9-pin min. valve sockets.
1 6AN7, 2 6N8, 1 6M5, 1 6V4 valves.

RESISTORS

1 10 meg. 1 2.2 meg. 2 1 meg. 1 .47 meg. 1 .27 meg. 1 .1 meg. 3 .047 meg. 1 75 ohm. all ½ watt.
2 .04 meg. 1 .022 meg. 1 175 ohm. All 1 watt. 1 .5 meg. pot.

CAPACITORS

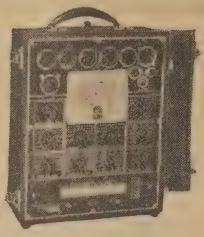
2 16 mfd 350VW electros. 1 8 mfd 350VW electro. 1 25 mfd 40VW electro.
3 .1 mfd 350VW paper. 1.02 mfd 350VW 1 .05 mfd 200VW. 1 .005 mfd 350VW. 1 .001 mfd 350VW.
1 425 pf mica (padder) 3 100 pf mica. 1 50 pf mica. 2 50 pf trimmers.

Sundries:

Solder, nuts, bolts, hookup wire, 12in shielded hookup wire, 2 5 terminal tag strips, 6 3 terminal tag strips, 6 x 6 in extruded aluminium grille, printed clock dial volume and tuning dial, 2 knobs, mains flex and plug, 3 rubber grommets.

AC-DC MULTIMETER

Model MVA/2: This popular Multimeter is built to careful standards of accuracy and utilises 1 pc resistors throughout to ensure maximum efficiency. It covers AC-DC and output voltage ranges up to 1000 as well as D.C. current ranges up to 250 milliamperes. In addition there is a special 10 ampere D.C. range as well as four ranges of resistance up to 1 megohm.

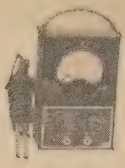


VALVE AND CIRCUIT TESTER

Model T.S.T.: This versatile happy instrument operates from either 240 volts A.C. or a 6 volt battery. This makes it ideal for bench or portable use and it combines the functions of an up-to-date valve tester with a wide range circuit tester covering D.C. and A.C. volts as well as output volts, condenser checks, current and resistance. Write for special bulletin.

SERVICE OSCILLATOR

Model YOA: An "on the beam" Oscillator for efficient, profit making, radio service work. Covers from 30 m.c. to 150 k.c. Can be used modulated or unmodulated. Features "Spot tuning" for fast work. Supplied with leads, dummy aerial and instruction book. Write for leaflet.



DC PORTABLE MULTIMETER

Model D.C.M.: This self-contained Multimeter is small and readily portable and is suitable for quick checking of circuits. It covers D.C. voltages up to 500 as well as D.C. current up to 250 milliamperes. Two ohms ranges are provided and it comes complete with test leads and instruction booklet.

4-INCH SQUARE METER

Model W-4: This all polystyrene meter pioneered by University Instruments provides the ultimate in appearance and accuracy. Available as an 0-1 milliammeter or any other type of standard range, it will enhance your equipment and yet will stand up to hard knocks as well as giving new beauty. This is one of the many meters in the University range.

30 KV TEST PROBE

Model B13: Although this high voltage probe is primarily designed for 30,000 volts test circuits, it offers a wide number of uses where polystyrene probes are required. It can be used for signal tracing work, high voltage work or a variety of other applications. Available with red or black handle as required.

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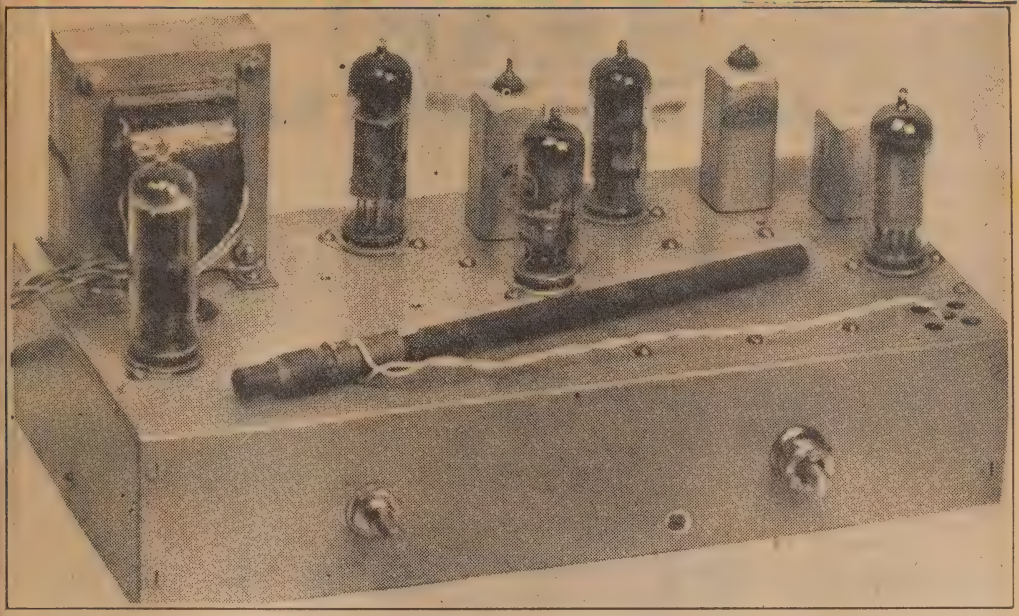
TEST PRODS

Type B1: These popular test prods come in pairs of one red and one black. Made of high quality moulded bakelite they have screw-in tips and are available at 3/5 per pair including Sales Tax.

TEST LEADS

Type B2: These popular test leads are of moulded high quality bakelite and come in a red and black pair. Standard tip jack plugs terminate one end and red and black braided wire of extra flexibility is provided. Push-on alligator clips allow the leads to be attached permanently to circuits. 10/6 per pair, plus 12½ pc Sales Tax.

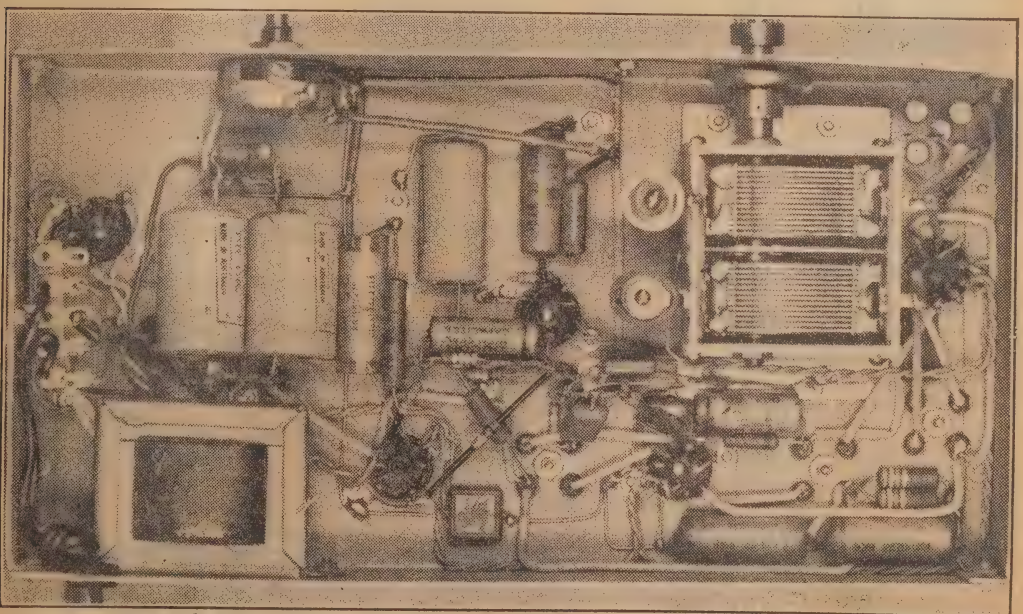
TWO CHASSIS VIEWS OF THE 5-VALVE CLOCK RADIO



A front view of the completed chassis. The new valve is in the centre of the chassis, just in front of the second IF transformer. The extra socket hole was provided in the original chassis and only a few small extra holes are needed.

The dial proper is a simple type, readily available from at least one manufacturer, in the form of a transfer which is mounted on a disc of celluloid. Letters are in black on a gold background, and scales may be obtained to suit the various states. A matching volume control scale is also available.

The conventional aerial coil is replaced with a ferrite rod aerial, which is very convenient where the signal level is adequate, since it avoids the usual trailing wire, which frequently does duty as an aerial.



The new socket is almost exactly central with the decoupling electrolytic to the left and above. The screen bypass is directly above with the .005 grid coupling capacitor alongside it. Note the new tag strip below and to the left.

In really difficult localities better results would be obtained by fitting an aerial coil and operating from an efficient outdoor aerial. Space has been left on the chassis for this coil to be fitted.

As a temporary measure, weak signals may be boosted by simply winding a few turns of insulated lead-in around the ferrite rod, assuming a reasonably efficient outside aerial.

AERIAL SUPPORT

The ferrite rod is supported from the inside top of the cabinet by means of two small brackets. These are normally supplied with the rod, but if you have to make your own be sure that they do not consitute a shorted turn around the rod, and which will seriously affect its efficiency. Also be careful handling the rod. They are very brittle and should be treated like glass.

Connections to the clock are shown in a separate diagram, and this should be read in conjunction with the coding letters of the power cable tag strip shown in the wiring diagram. A three-wire cable (three lengths of hook-up wire plaited) connects the clock to the tag strip and a similar cable serves for the loudspeaker. In this case the third wire is to earth the frame and voice coil. Both leads pass through grommeted holes in the chassis.

The cabinet is made from 3-8in thick bonded plywood, and all the essential dimensions are given in the accompanying drawing. However, it should be finished by rounding the corners as shown in the photograph at the beginning of this article.

ROUNDING DETAILS

A rasp, a plane or some coarse glass or garnite paper may be used for this purpose. The exact amount of round produced will depend to some extent on taste, but, in general, we suggest the maximum that can be tolerated without weakening the corners. About ¼in radius will be about right. Watch for nails if you are using a plane.

Dress the whole cabinet to a smooth finish with fine glass or garnite paper, make sure that all the dust is removed, and then finish with a glossy lacquer. The color may be chosen to suit your own taste or to match the color scheme of a particular room.

The clock we used was supplied without a printed scale so we made one for our own use and printed a quantity for our readers also. They are available through the query service.

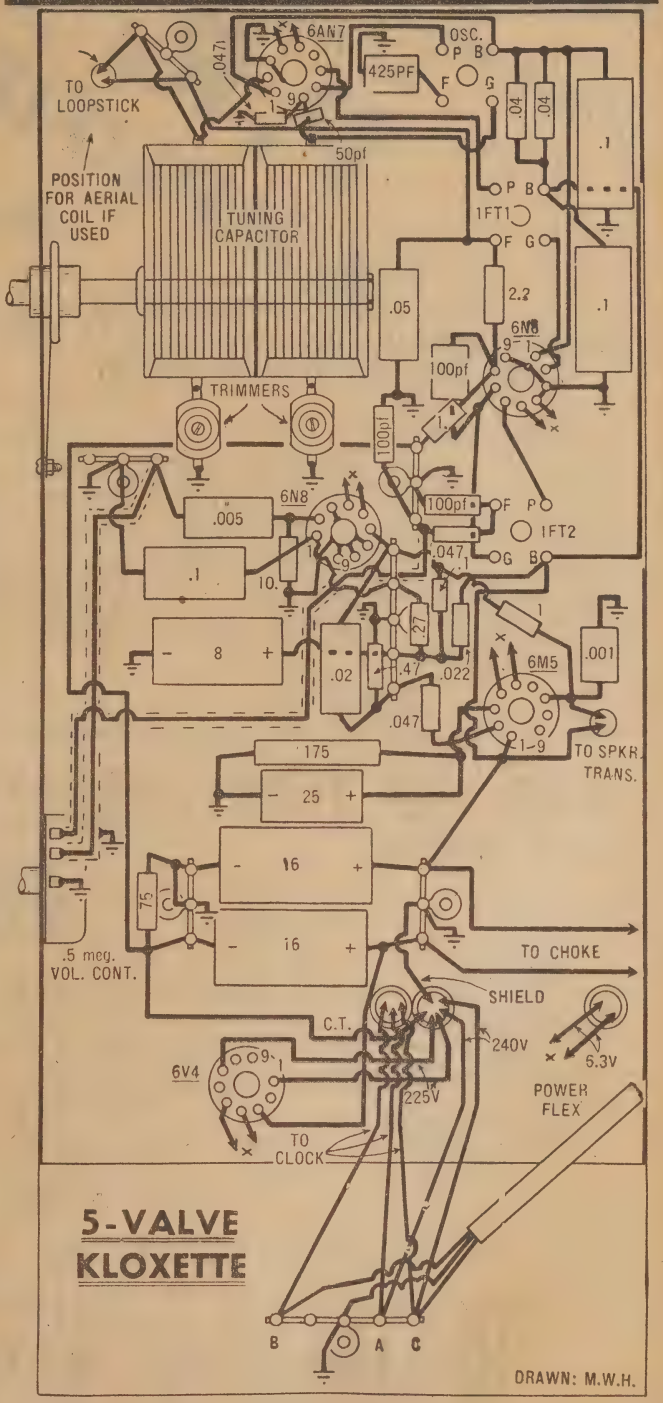
This covers most of the vital points raised in the original constructional article and should bring the new reader pretty well up to date. From here on we will discuss the fitting of the additional valve.

The extra valve socket is accommodated in a spare hole which we thoughtfully provided in the original chassis for just this purpose. It is located alongside the second IF transformer in a spot which provides a clear space under the chassis for the extra bits and pieces.

We chose another 6N8 for this stage, simply ignoring the diode plates by connecting them to chassis. For bias we had the choice of a cathode resistor-capacitor combin-

(Continued on Page 73)

THE RECEIVER WIRING DIAGRAM



This wiring diagram should help you locate all the parts as they were on the original. It should also help the beginner who may be puzzled by the circuit.

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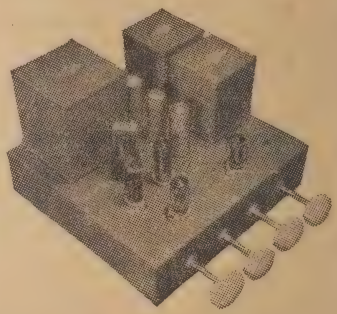

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PHILIPS

Model AG2002 3 Speed Record Player with high quality turn-over crystal (Recommended by Mullard for use with their amplifier). **£12/-/-**

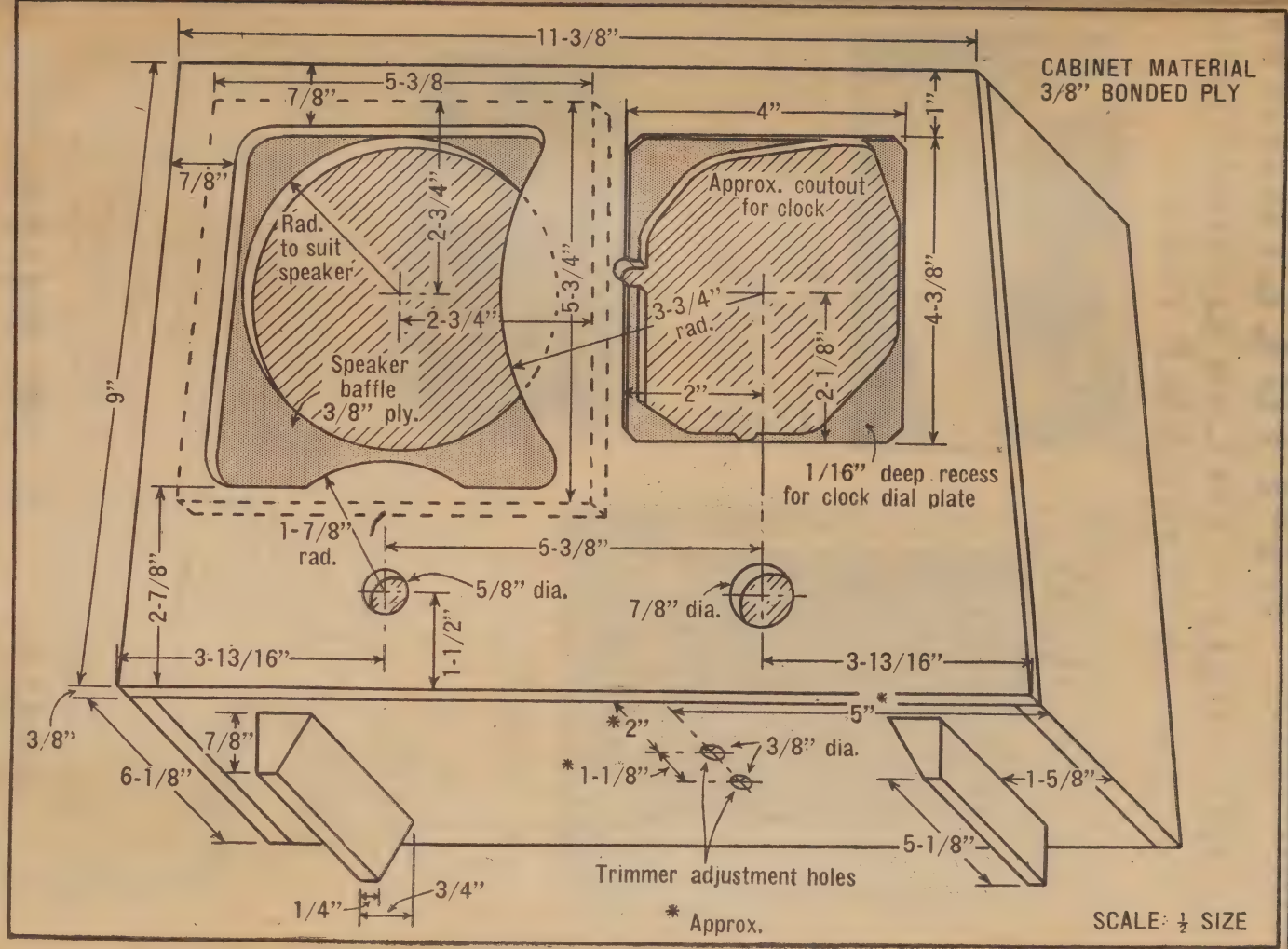
MULLARD 5-10 KIT

The Mullard 5-10 Amplifier is one of the best for the home constructor. Refer to Mullard advert in R & H Sept. for details. Complete kit including Bramco transformers. **£22**

PRICE'S RADIO

5-6 ANGEL PLACE, SYDNEY

MAKE YOUR OWN CABINET FROM THESE DRAWINGS



This drawing contains all the dimensions to enable you to re produce our original cabinet. Note, however, that the corners are to be rounded after assembly. Check the clock cutout to suit your particular model.

Steane's HI-FIDELIGRAM

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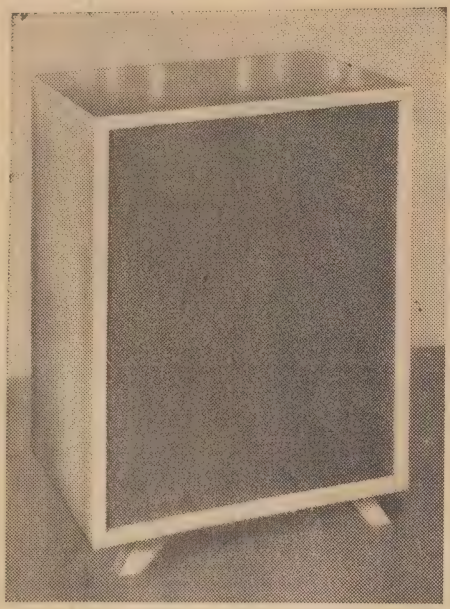

Speaker System

Speakers: 12in low note speaker and 6in high note speaker.
Filter: Constant resistance half section.
Crossover Frequency: 1000 c/s.
Type of cabinet: Vented Enclosure.
Impedance: 15 ohms.
Power Handling Capability: 15 watts.

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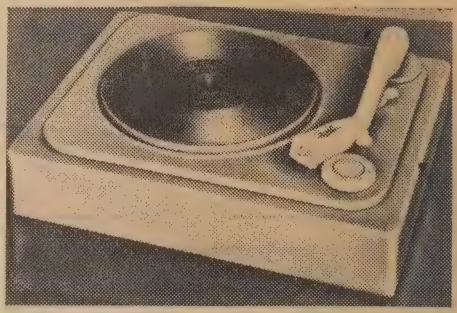

Record Player, specially selected three-speed turntable and PU on base.

Response: Connected directly to amplifier with tone controls set for flat response — within 3db of R.I.A.A. characteristic from 30 to 10,000 c/s.
Needletip Weight: 5/16oz.
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Power Output: 10 watts in push pull.
Harmonic Distortion: Less than .1 pc at 8 watts.
Intermodulation Distortion: Less than 2 pc at 10 watts using 4 to 1 ratio of 40 and 5000 c/s.
Input: 500,000 ohms at 250 mV.
Signal to Noise Ratio: 70db.
Tone Controls: Continuously variable bass and treble giving plus or minus 12 db at 30 c/s and 15,000 c/s.
Output Impedances: 2, 8 and 15 ohms.
SPECIAL FEATURE: Visi-aid indicators enabling compensation to suit recording characteristics.

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ation or the use of a high value (10 meg.) grid resistor. We settled for the latter as being simpler and cheaper without any serious disadvantages.

We also added a simple feedback circuit, consisting of a one meg. resistor from the plate of the 6M5 to the plate of the 6N8. This helps to level out the response and take care of varying speaker load impedance, &c.

RF FILTER

Due to the higher gain in the audio section we found it necessary to provide a rather more elaborate RF filter in the diode load circuit, otherwise there was a chance that RF would find its way through the audio system and cause instability when the gain was fully advanced. As an additional precaution against this, it is advisable to make quite sure that the speaker voice coil and frame are both earthed to the main chassis.

In place of the simple 250 pf by-pass at the hot end of the diode load, which was adequate when no audio stage was used, we now have a .047 meg. decoupling resistor with a 100 pf capacitor at each end.

As a natural precaution against hum and low frequency instability, we decoupled the HT supply for both plate and screen, using a .022 meg. resistor and an 8 mfd. electrolytic.

This may be looked upon as something of a refinement, but, we think, a very desirable one. Admittedly, it is seldom employed in similar commercial sets, even where the mains filter system is by no means as generous as ours. Since the public seems content to tolerate the resultant hum level there may be some doubt as to the value of this additional precaution.

HUM PROBLEMS

It is true that the hum level encountered in such sets is usually not objectionable when the set is used in the usual way, that is in the kitchen or lounge room with the volume at a level to fill the room. The reason is simply that the hum level is then so much lower than the signal level that it is virtually inaudible.

But take one of these sets into the bedroom, put it on a bedside table, and operate it about a foot from your ear. Then you have a vastly different story. Because of the proximity of the speaker, plus a possible desire not to disturb other people, the volume will be turned well down. But the hum, being injected into the audio channel between the volume control and the speaker, remains at the same level as before. The result is a hum level which is quite high relative to the program and which can be most objectionable.

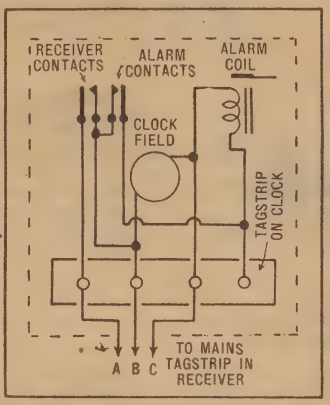
For this reason we feel that any set which is likely to be used as a bedside set (and the Kloxette most certainly is) should have the lowest possible hum level, certainly lower than is possible with many commercial sets.

Those who may feel that we are being unnecessarily fussy and are keen to save a few shillings, may omit the decoupling components. The result will still be better than many commercial sets, but not quite as good as our original.

Coming to the more practical side we have to consider the physical changes necessary to accommodate the extra components. In the original layout a four terminal tag strip was used to mount the 6M5 grid stopper, the bias resistor and capacitor, and the .02 coupling capacitor.

This is replaced with a five terminal strip mounted at right angles to the old one, and running alongside the 6M5 socket and the 2nd IF transformer. Its position can be seen in both the under chassis photograph and wiring diagram. On this is mounted the 6N8 screen and plate resistors, the 6M5 grid resistor, and the .02 coupling capacitor.

It also provides terminals for the 6M5 grid stopper, the feedback resistor, and the HT decoupling resistor and capacitor. The 6M5 bias components occupy approximately the



This clock diagram should be studied in conjunction with the receiver wiring diagram, on which the corresponding connections are marked.

same position as before, but are earthed at a solder lug which also serves the negative end of the decoupling electrolytic. A new hole must be drilled in the chassis for this purpose.

A two terminal tag strip which previously supported one end of the one meg. AVC resistor and the back bias lead must be changed to a three-terminal type. The new strip serves the same purpose and in addition supports one end of the .047 meg. RF decoupling resistor, one end each of the 100 pf by-passes, and one end of the shielded cable to the volume control.

A three-terminal tag strip is also fitted near the front of the chassis approximately in line with the new socket. It serves to terminate the .005 mfd coupling capacitor and the shielded lead from the moving arm of the volume control. A solder lug under the same mounting bolt serves to earth the .1 mfd screen by-pass capacitor.

The new socket is mounted so that the gap in the pins is toward the volume control. An extra filament line is run from any convenient socket and we chose the 6AN7 as being the easiest. Pins 3, 7, 8, and 9, being the cathode, diodes, and suppressor in that order, are all earthed, along with the centre spigot.

Taking into account these points

(Continued on Page 127)

NOW IS THE TIME

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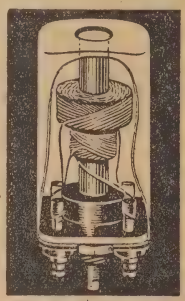

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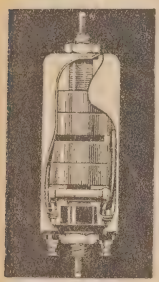
To suit 1R5 converter. Only ¾in square and 1 3/8in high. Litz wound primary and secondary iron cored. **RETAIL PRICE 12/8.**



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Only ¾in square and 1 3/8in high. High Q. Litz wound secondary iron potted and cored. Secondary tap brought out to base pin. Single hole mount.

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Only ¾in square and 1 3/8in high. High Q. Litz wound secondary iron potted and cored. Secondary tap brought out to base pin. Single hole mount.

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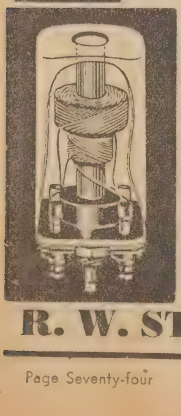

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TYPE: CRK2. IF1, IF2, AC2, O5, IC1.

TYPE CRK2 a IF1, IF2, AC7, O5, IC1.

TYPE: CRK3. IF1, IF2, RC2, AC7, O5, IC1.

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PARTS FOR AUDIO GENERATOR

In response to requests from a number of our readers, who are building our new Audio Signal Generator, we give here further details about the availability of some of the special components used.

FIRSTLY there are the resistors for the oscillator frequency determining circuits. These should be preferably of the high stability cracked carbon type.

This type of resistor is very stable in its resistance and can be manufactured to close tolerances.

The resistors are being made in small quantities by at least two local manufacturerss, namely Ducon Condenser, 887-895 Bourke Street, Waterloo, NSW, and I.R.C. (Wm. J. McLellan and Co. Pty. Ltd.), 126 Sussex Street, Sydney.

At the present moment the supply is not good, particularly in the higher values, but this position will no doubt improve as the demand increases.

If this type of resistor cannot be obtained, the normal carbon types could be used. As was mentioned previously it is not so much their absolute value which is important but the fact that they should be matched as nearly as possible in pairs.

A change in the absolute value will only effect the range covered by that particular pair of resistors, whereas a difference of value between two of a pair will change the feedback conditions in the oscillator.

The main tuning control of the generator is a miniature two gang receiver condenser. The one we used was manufactured by Philips Electrical Industries, and should be the variety not fitted with trimmer condenser plates. This gang is small in size and uses ceramic insulation.

WHERE OBTAINABLE

Supplies of these gangs are available from the manufacturers at their head office at 69 Clarence St., Sydney, or from branch offices in other States.

Other types of gang could be used but, to our knowledge, this is the only type available locally which has ceramic insulation and is as small physically.

Some excellent overseas gangs have been available from time to time, but we felt that we should if possible use a gang which is readily available on the local market.

Some of the imported gangs are available with insulated rotors, which is of considerable assistance in screening the oscillator stage, as the gang frame can be earthed. This then acts as the screening for the active circuits.

Gangs are also available on occasions from disposals suppliers but, in general, they are somewhat larger and the chassis would need to be adapted to suit.

This is particularly the case if an ex-disposals type four or five-gang condenser is used, as has been suggested by some of our readers. The intention in this case would be to parallel each of two sections to increase the total amount of capacitance.

While this does reduce the value of resistance required for a given range this is not the full story. Because of the larger dimensions of the gang the inherent strays may be higher. Also, unless the screening box is made a prohibitive size, the frame to ground capacitance will be greatly increased.

The overall result may well be inferior to that obtained with the simpler arrangement used in the original instrument.

For the range switch a ceramic type is to be preferred. These are manufactured by Manufacturers Special Products, 47 York St., Sydney, and supplies can be obtained through normal trade channels on special order.

At the risk of some change of calibration in damp weather on the lowest frequency ranges, the normal bakelite type wafer switches could be used. Care must be taken to see that these are scrupulously clean and free of any flux.

CERAMIC INSULATORS

The ceramic stand-off insulators are manufactured by the United Capacitor Co. Pty. Ltd., 433 Punchbowl Rd., Enfield, NSW. The type number is SI-2 and these are obtainable from the manufacturers.

As a possible substitute for these some small diameter polystyrene rods could be used in much the same way as was done for the gang mounting pillars. The main limitation here is probably the space into which these have to be fitted.

The Thermistor is a Standard Telephones type A5412/100 and can be obtained from them at 252-274 Botany Rd., Alexandria, NSW. At the time of writing the supply position is not good but further supplies are expected from overseas in the very near future.

The use of a Thermistor is much to be preferred to the lamp for control purposes as it is free from "hunting" effects and the output level is held to much closer limits. Also the large range of Thermistors which are obtainable enable the best operating conditions to be chosen.

The Thermistor also scores on the basis of size, as it can very readily be fitted into the shielded compartment of the oscillator.

The attenuator resistors in the original instrument were also of the high stability carbon type for the two highest values and wire wound types for the two lower values. A point of importance here is that the 1000 ohm resistor be made of the two-watt type, as there is a considerable amount of power dissipated in it.

The meter used in our instrument was a University Graham type S3/181. This is a 3in meter and is fitted with a special scale for the Audio Generator, marked in dbs and millivolts. This meter is available from the manufacturers at 5 North York St., Sydney.

The cursor used for the main dial was made in our workshop from some 1/16in perspex and is affixed to a standard instrument knob.

OTHER COMPONENTS

All other components in the oscillator are standard radio components and no difficulty should be experienced in obtaining these from your usual supply house.

Several queries have also been raised as to the rise time of the Audio Generator.

In any system in which the square wave is obtained from the simple limiting and squaring of a sine wave, some initial slope of the wave front is inevitable because of the slope of the sine wave itself. However, in the circuit which we used, this effect is minimised.

A further limitation is that imposed by the frequency response of the other circuits. This becomes evident as we approach 50 Kc/s.

We checked the rise time at 50 Kc/s and found it to be of the order of 2 microseconds. To relate this to more usual terms, this is the same as the time taken for a complete cycle of a 500 Kc/s wave to take place.

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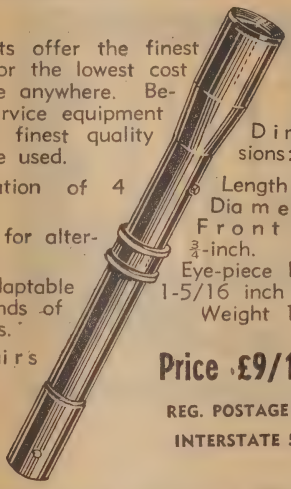

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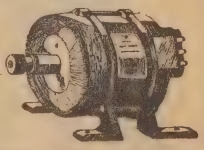

A very useful 50-volt, 50-cycle Motor, which can be rewound to approximately 1-10 h.p., 230-volt A.C. It has a ⅜ inch shaft, self-aligning ball races. Ideal for handymen and hobbyists: 25/-.
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HYDRAULIC POWER IN INDUSTRY

(Continued from Page 19)

tion cap which, when it comes into contact with the roof, holds against it securely, while an automatic arrangement in the cap sets a limit to the pressure which can be applied in order to avoid too much stress.

When a tunnel is worked out, the prop is easily recovered by attaching a cable to the relief valve and, from a safe distance, releasing the fluid, whereupon the jack is lowered and pulled to safety.

This is a great safety device, as there is great danger in removing the conventional wooden struts holding up the roof of a mine.

One of the greatest of agricultural implements is the Ferguson tractor.

The conventional method of using a tractor is as a prime mover for drawing say a plough or harrow or other agricultural implement at the rear. These had to be very heavy in order to achieve traction.

THE FERGUSON SYSTEM

With the Ferguson system the tractor is comparatively light, and the implements are carried underneath the tractor. These add the necessary weight and are raised and lowered by precision hydraulic means. The whole scheme is a great advance on conventional methods.

An outstanding development in shipbuilding are the stabilisers which are now being fitted to modern ocean-going liners such as the Arcadia.

These consist of streamlined fins set below the waterline of the sides of the ship. They are shaped somewhat like the ailerons of an aeroplane and act in a similar fashion.

They are really balanced streamlined rudders lying in the natural streamline on the side of the ship. They are arranged to rotate on a shaft, are balanced, and can be turned easily to suit the local conditions. The turning is done by hydraulic means and when not in use the fins are hydraulically retracted into recesses in the side of the ship.

BIG CORRECTION

It is claimed that a 14-degree roll can be reduced to one or two degrees by means of the stabilisers.

This might easily lead to higher fares because passengers may begin attending the dining room during the voyage! However, that's not my worry.

It is interesting to note that the steering of these large ships is also done by hydraulic machinery.

In aircraft the variable pitch of the propellors is accomplished by means of hydraulic machinery while the propellor is revolving. This varying of the pitch is necessary to allow for various flying conditions.

Then there are rivetting machines, shears, elevators, die-casting machines. In fact, the modern applications of hydraulics are legion. Sufficient has been said to show the importance of this great power for the aid of industry.

This is the 17-watt Playmaster amplifier the performance of which is discussed in this article. It more than compares with any commercial equivalent.

HOW GOOD ARE OUR AMPLIFIERS?

How good need an amplifier be to be good enough? A difficult question, for it is not yet established what is the maximum order of performance needed to cater for the most exacting type of signal input. This article outlines some of these difficulties, and attempts to provide an answer and to assess the performance of Playmaster amplifiers and some commercial types on this basis.

by John Moyle

EVERY so often a reader writes to ask us which is the best amplifier he can buy or build. He has saved up his hard-earned cash and wants to make the best use of it.

Even more frequently we are asked whether the "Playmaster" amplifiers are as good as commercial types.

The implication is that, having been designed and built by amplifier specialists, factory-made jobs must be superior.

We don't like making comparisons between commercial amplifiers for many reasons. To be fair, we would need full test figures on them all, which is impracticable, and a full knowledge of the conditions under which the preferred amplifier would be operated, which is impossible.

FAIR CLAIMS

Most amplifiers bearing reputable names substantially live up to the claims made for them and we don't know of any which should be avoided because of outstanding faults. Their price varies according to the facilities offered, many of which have no direct bearing on the standard of performance.

It isn't so easy to avoid answering the question about the Playmasters, however, nor is there any reason why it shouldn't be answered at least in broad terms.

We think our readers are entitled to know how they stack up against commercial amplifiers, and if they are as good or better. Most references are to the higher quality amplifiers, which at least clears the air!

It isn't necessary to go through a full and lengthy test procedure to supply such an answer. The presence or absence of serious faults can be detected by a comparatively few standard checks, and by intelligent interpretation of the results.

We can show the performance figures and curves of the 17-watt Playmaster, for instance, together with those of a high-grade commercial type, and let them speak for themselves.

But in attempting to make such a comparison it would be quite unfair not to point out the danger of over-emphasising the significance of at least some of the performance figures.

These mean very little unless they are related to what might be considered optimum design.

PRACTICAL STANDARDS

An amplifier should not be judged by how much better it is than it need be, but how completely it meets the specifications known to be adequate to do its job with complete efficiency.

There must be a certain standard of amplifier performance beyond which there is no benefit to be gained. Every amplifier which at least meets this standard must be considered of equal quality as far as listening is concerned.

The trouble is to find out just what this standard is. It involves so many judgments that so far no one seems to know the answer. And yet it is essential to have some ideas about it before deciding, not which amplifier is the best, but whether any of them are good enough.

A commercially made amplifier must be designed to some such specification, for the cost of manufacture must be kept within a reasonable limit. Neither the maker nor the customer is served by adopting a standard higher than is necessary to set a reasonable selling price.

A custom-built amplifier, on the other hand, can often show results better than those of even high-grade commercial units, but which may not, in the long run, be realised by ordinary listening.

Cost for cost, there is every reason why equipment should be made as good as it can be made, but even with an extra margin of performance, there must be some limits set by somebody in calling a halt.

In other words, it is becoming more and more important to find out just how good an amplifier should be to give us top performance.

But engineers and musicians are still far from unanimity about the answer.

AMPLIFIER FUNCTIONS

As a background to a discussion of amplifier standards, let us consider why we use amplifiers, and what we expect them to do. The reference, of course, is to amplifiers used for reproduction of speech and music primarily in the home.

We often hear it said that an amplifier should reproduce as near as possible a live performance.

But the sound of a live performance is not something which can be packaged, removed from a concert hall, and released under other conditions without substantial change.

It is not even a finite thing, for it is made up of the sound from the instruments or voices themselves together with an infinite number of reflections inseparable from the hall.

It will vary to a vast degree from one position in the hall to another. It is affected appreciably by the size of the audiences and by many other variable factors.

For practical purposes, we must use one or more microphones with characteristics different from those of the ear, convert their output into sound via a single channel, and one or more loudspeakers, projecting the result into a room with acoustic properties largely uncontrollable. We must adjust the volume level for the listener's comfort, and sometimes for the comfort of the neighbors.

In most cases, the reproduced music sounds wonderful, but it has no direct relationship to what a listener heard in the hall.

Nor is there any reason why it should, when we can convert a necessity into a virtue.

MIKE PLACEMENT

The microphones can be placed to detect much more of the orchestra and in better over-all balance, with enough reverberation so that, when added to that provided by our lounge room, it gives a clear but lively sound to the music.

We have not duplicated reality as represented by a seat in the hall. We have presented the music in a new way so that, by preserving and even enhancing the impression of the original, it could only be approximated by the best possible listening position in space.

This is an essential difference and our thinking must start from this point.

Only once have I heard reproduced music so like the original as to give me the uneasy sensation that the performer was present in the room. I was using a vocal demonstration record. The piano accompaniment wouldn't have fooled anyone, but the voices were uncanny.

One or perhaps two instruments might have duplicated this performance. But an orchestra or a choir — never. Psychologically, apart from any other considerations, they would have been rejected.

QUALITY STANDARDS

What are the requirements for the finest reproduction?

Primarily we must receive a vivid impression that the instruments or voices we are hearing are those which made the original sound. To achieve this we look for an absence of any unpleasant distortion, and clear recognition of separate sounds either individually or in combination, and sufficient volume to create and maintain a sense of acoustic proportion.

These requirements make it possible for us to almost duplicate a live performance in some cases, but they do not depend upon it.

Our ears and our listening habits are so accommodating that we will accept an extremely wide variety of reproduced standards with pleasure. But if we demand a system which does all these things with the best possible effect, I feel we have approached nearest to what we call high fidelity.

The first step in evaluating an amplifier is to establish how good it needs to be in achieving all these things, and to relate this to the performance it is practicable and economical to achieve. No amplifying system is or can be perfect — like all other engineering projects it demands compromise. It is our job to see that the amount of compromise is kept to a minimum.

Maybe we can now be more specific about technical matters.

The frequency response of the amplifier is very important, and can often point to faults or absence of faults.

It is essential to know that the amplifier has an even response over the full range required for the reproduction of voice and music.

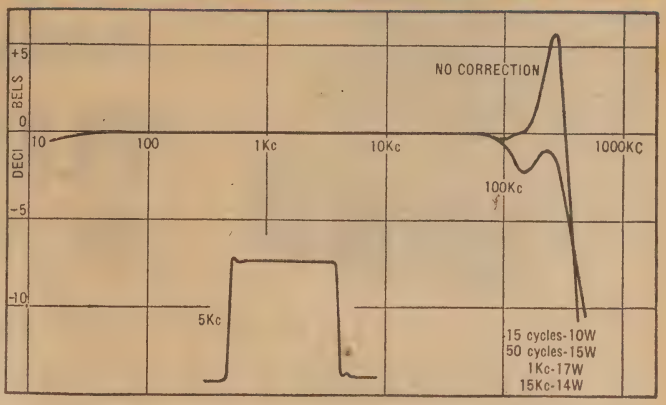
But its behavior beyond this point and up to several hundreds of kilocycles might show irregularities which will allow oscillation, overshoot and ringing, all of which will degrade amplifier performance in varying degrees.

Thus we will separate these two ranges for the purposes of examining their application to our problem.

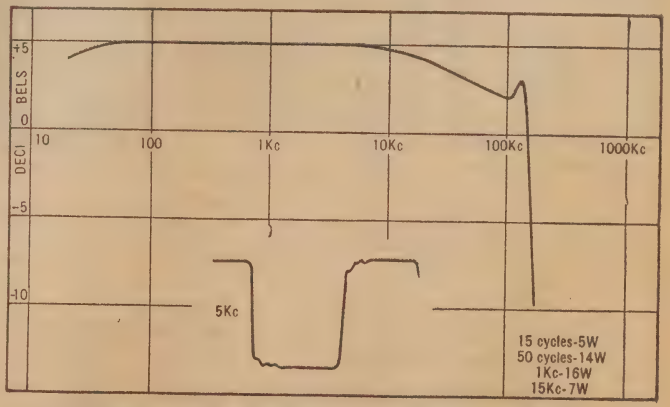
The fundamental frequencies involved in speech and music run from about 35 cycles per second to 4.5 Kc or thereabouts. But as there are few pure tones in practice, the amplifier pass band should be extended to cover all the harmonic frequencies as well.

Because the limit of hearing — the highest frequency at which normal-strength sounds can be detected — is generally set as being about 18 Kc., it is generally considered un-

PLAYMASTER PERFORMANCE CURVE



The response curve of the Playmaster is almost flat from 15 cycles to 300 Kc and its power rating is very good. Square wave response is better than any other amplifier we have tested. Even at 20 Kc it is substantially square, and there is virtually no ringing.



These results were obtained from a high quality commercial amplifier of world reputation—two samples of which behaved similarly. They do not compare with the Playmaster results, although distortion is quite low. But this amplifier still sounds good. Test procedure was identical.

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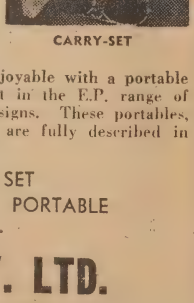

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necessary to worry about frequency response above that figure. Even 10-15 Kc is often considered high enough, on the assumption that realistic reproduction requires no more.

A frequency of 15 Kc represents the third harmonic of 5 Kc and is short of the fourth harmonic at 4 Kc. To accept a limit of 15 Kc therefore, although probably adequate for many sounds, may be based on the idea that we cannot hear appreciably higher than this rather upon the fact that these extreme frequencies are unimportant or non-existent.

But is it safe to work on such assumptions? Sounds as produced by cymbals, for instance, contain harmonics well into the super-sonic region, and the presence of such harmonics may well be detected by the nervous system even when the frequency is beyond the primary range of the ear.

Tests with an oscillator and a suitable radiator will soon prove this point, particularly if the effect is aggravated by using a more than normal power output.

Hearing is actually a process whereby the brain is stimulated by a nervous reaction, and anything which contributes to this reaction must be considered part of a sound as we hear it.

Not all sounds involve the use of these very high frequencies, but we must consider them when setting limits for a high-fidelity system. Not all records, pick-ups and loud speakers — in fact only the very best — are likely to reach these limits. But it is now no problem to record and reproduce from records frequencies up to 20 Kc and even higher.

We will certainly improve on this as time goes on.

TOTAL RANGE

I would say, therefore, that we should aim at a perfectly flat response as high as 30 Kc to be on the safe side for a really good amplifier.

Furthermore, if other requirements of a good amplifier are to be met, the inclusion of such a range will be almost automatic.

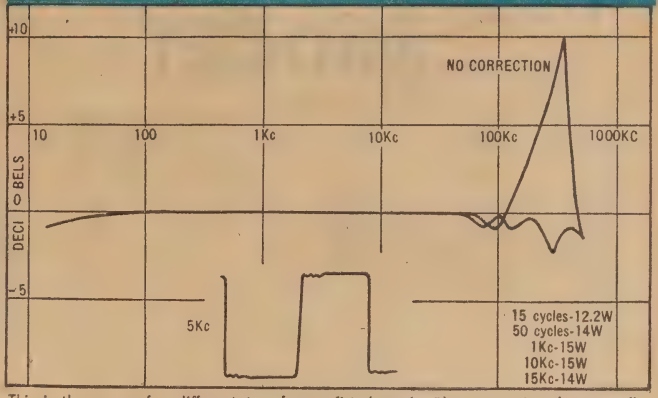
What a pity it is that our hearing deteriorates as we get older, and can probably make best use of it while in our callow youth it is at its keenest!

On the low frequency side, there seems little reason to bother about frequencies below about 30 cycles. Even here we reach the realm of feeling, and really need to install our amplifiers in special auditoriums to make full use of such a range. We do hear of records including frequencies down to 16 cycles, but the task of reproducing these notes is very great.

You can trace out a standing wave at 20 cycles if you are able to walk in a straight line away from the loudspeaker, but you may have to move into the next room to avoid dead spots, and anti-nodes, all of which makes it rather difficult. We are assuming that you wish to hear your records sitting round the fire in a good-sized living room!

In a well-designed amplifier, the ultimate frequency response is almost entirely due to the characteristics of the output transformer, which is its most important single component.

SOME TRANSFORMER COMPARISONS



This is the curve of a different transformer fitted to the Playmaster. Its phenomenally wide range—1 db down at 500 Kc, is obtained at the expense of extra ringing from internal resonant circuits. These show up when the main peak is phased out. Note the extreme height of the peak without compensation. Its power curve is excellent but it was unstable with large amounts of feedback in our circuit. It can be classed as "too good".

This is one reason why negative feedback today is invariably taken from the secondary circuit of the output transformer, so that it is included in the feedback loop.

In essentials, negative feedback consists in feeding back energy from the output circuit 180 degrees out of phase with that appearing in the input circuit.

Any tendency for the response to vary over the frequency range is resisted by the feedback circuit.

In an ideal transformer, having an absolutely even response, feedback would be constant at all frequencies, and there would be no limit to the amount we could use.

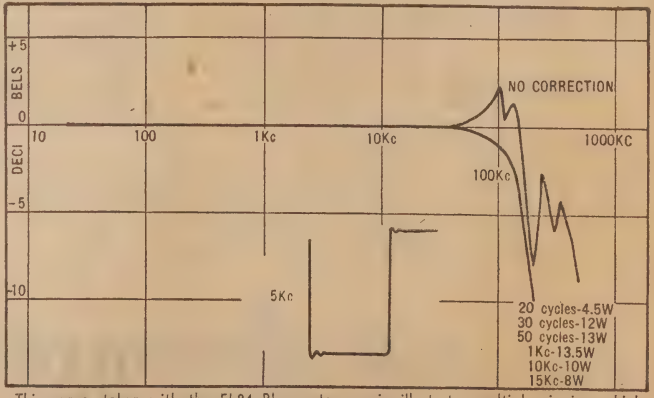
But because there is a limit on the inductance which can be built into a transformer, the response will fall at the bass end, dropping to zero at zero frequency. It will also fall at the high frequency end, usually from about 20 Kc or so according to design, mainly due to capacitive losses between the windings and lack of coupling between them.

It is obvious, therefore, that although feedback may be reasonably constant in the centre portion of the response, where the gain is similarly constant, it will be reduced in some degree in the upper and lower regions where the amplification falls away.

If there is some sudden discontinuity in the ideal, smooth attenuation curve, it is almost certain that the feedback voltage will not preserve its initial negative relationship with the input voltage, and if the change is sufficiently acute, it may even rotate far enough to become positive.

In such a case oscillation will take place, once the circuit damping is overcome, and it will occur at a frequency related to that at which the discontinuity is found. It can thus occur at very low or very high frequencies, or both.

In every output transformer the winding inductances and capacitances form a series of tuned circuits. The more sections in the



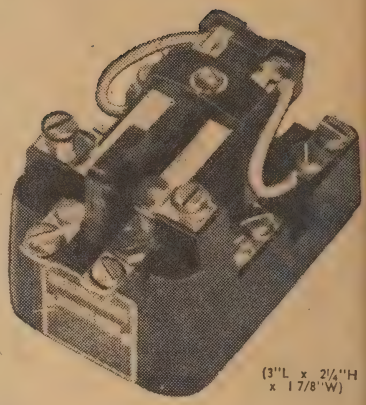
This curve, taken with the EL84 Playmaster, again illustrates multiple ringing which persists even after correction. No pronounced overshoot occurred. The U-L tap was only 5 per cent with this transformer. Feedback 20 db.

RELAYS
MIDGET

Cat. No. Surface Mounting Type	No. of Poles	Normal Contact Position
28300U 28302U 28304U	1	open closed open and closed
28306U 28307U 28308U	2	open closed open and closed
28311U 28312U 28313U 28314U	3	3 open 2 open — 1 closed 1 open — 2 closed 3 closed
28315U 28316U 28317U 28318U 28319U	4	4 open 3 open — 1 closed 2 open — 2 closed 1 open — 3 closed 4 closed
28325U	3	3 pole Change-over

OPERATING COILS

A.C. Voltage 50/60 cycles	D.C. Voltage
6	6
12	12
18	18
24	24
32	32
110	36
220	50
440	115
550	230



(3"L x 2¼"H x 1 7/8"W)

Sheet metal case available

Volts	Each Pole amps.	2 Poles in Series amps.	H.P.
110 A.C.	10	10	¼
220 A.C.	10	10	½
440 A.C.	5	5	½
115 D.C.	0.5	2.5	—
230 D.C.	0.3	0.5	—

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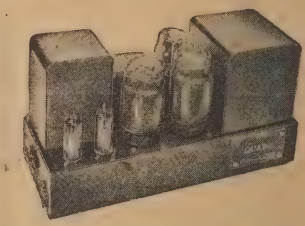
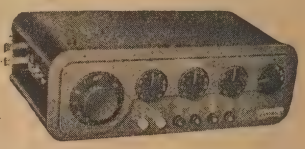
	Goodmans Axiom 150 Mark II	22 16 10
	Barker	29 11 7
TEST RECORDS:	D.G.G. LP. Test Records, each	2 4 6





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ansformer, the more tuned circuits will have.

The main resonances formed by e total inductance of the windings id the capacitances between them id earth are too low in frequency cause any trouble. But those rmed by the capacitances of the indings and the leakage inductance tween the primary and the second-y—an inductance representing the ss or phase lag in mutual coup-ng—become very important in the rformance of amplifiers with over-l feedback. It is possible that the condary winding inductance may so be responsible for introducing resonant circuit.

ARGE PEAK

In a simple type transformer, in hich the capacitance is compara-vely large, a high-Q circuit will found very close to the top of e audio range, and even medium-ade transformers might exhibit a rong resonance peak as low as Kc.

In such an amplifier even a modest nount of feedback might be enough cause oscillation, which can only cured by reducing the over-all equency response by some method that the attenuation at the peak equency is great enough to prevent cillation.

For instance, a phase-correction pacitor could be included to ad-nce the phase of the feedback oltage, thus providing more feed-ck and reduced gain at or below e critical frequency.

Such a course will inevitably cause high-frequency roll-off appreci-bly below the peak frequency and obably below our upper limit. here is grave danger, too, that large nounts of correction will send the edback positive elsewhere in the nge, unless the amount of feed-ck is reduced.

To make a good transformer, there-re, it is necessary to have adequate imary inductance, low inter-wind-g capacitance, and low leakage in-uctance.

These are not completely com-atable. High inductance calls for any turns. Low capacitance calls r extra spacing between them, hich makes it difficult to preserve e efficient coupling between pri-ary and secondary necessary for w leakage inductance.

Standard practice is to break up e primary and secondary windings nto sections, inter-connected in such way as to reduce capacitances with-ut prejudice to the more intimate oupling between windings.

This method generally pushes inding resonance well up into the upersonic region, and the more sec-ions in the transformer, the more esonance peaks are likely to appear

OSSIBLE OSCILLATION

Some are sure to combine to give ne or more peaks of a high ampli-ude, and there is still the danger f oscillation with high degrees of eedback, even though the actual mount may have dropped to a raction of its original value.

It is now possible, however, to phase out" a resonance peak with-ut causing frequency attenuation within the useful band. For in-tance, a transformer with a pro-nounced peak at 160 Kc may be so reated without detriment to fre-uencies below 100 Kc or even igher.

The point is, however, that without a full knowledge of the frequency response at several hundred kilocycles it may not be possible to design a stable amplifier to accept an adequate amount of feedback.

This is the key to our interest in the supersonic frequency range of the equipment.

Even with the amplifier quite stable under sine-wave tests, it may still be excited into oscillation when fed with a steep wave-front as produced by a signal rich in high order harmonics.

Even if the oscillations are sufficiently damped to limit their duration to only a portion of the operating cycle, this may be enough to spoil the transient response of the amplifier—its response to very sharp sounds.

EFFECTS OF RINGING

This is what we mean by "ringing", and there is considerable difference of opinion as to the latitude which can be allowed in respect to it.

Apart from spoiling the transient response of the amplifier, ringing absorbs power which should be spent in performing useful work, and in extreme cases it can cause the amplifier to overload at high frequencies with drastic results on quality. It is, in fact, short-term oscillation at some supersonic frequency.

The standard method of testing for ringing is to feed a square waveform into the amplifier having a "rise-time" at least equal to that of any likely frequency met with in practice. The "rise time" is the time taken for the steep wavefront to rise from the bottom of its trace to the top.

This time determines the maximum frequency represented by the "square" wave.

Because such a waveform will include all frequencies up to this figure, it will excite any circuit resonant at a frequency up to this limit, and each such circuit will tend to ring.

A multiple-wound transformer, which might have several resonant circuits, cannot include phase compensation for them all, but the circuit is generally treated to remove the effects of the most prominent peak, which is usually lowest in frequency. Such a transformer can be made to show an excellent frequency response up to .5 Mc or better, but is almost certain to exhibit waves on the flat top of the curve representing its various resonances.

SEVERAL PEAKS

It is extremely likely, too, that such a transformer will be running close to the stability danger line at extremely high frequencies, which, in any case, are far too high to be significant in audio work.

As some of the curves given here will show, it is possible to design transformers at reasonable cost, which cause a variation only a few db up to 200 or 300 Kc, and which are still able to show a very good waveform on a square wave test.

The square waveforms used in our tests are at 5 Kc, which is generally accepted as being the most

iseful frequency, and with an estimated rise time of about 2-3 microseconds. But do we in fact ever xperience waveforms with a wavefront as steep as this?

It is extremely difficult to answer uch a question. One estimate we ave heard puts the maximum at o more than 7 microseconds, but, ven that may be too small a figure.

Obviously, the slower the rise time, he lower will be the frequencies t which ringing can be initiated, lthough the ringing which does ake place at frequencies lower than epresented by this rise time will till show up.

RISE TIME

If we assume 30 Kc to be the highst frequency in which we are interested, it will be accommodated y a square wave with a rise time f about 33 microseconds.

It would not be logical to claim his as a limit, however, for resoant circuits may still be excited y frequencies some distance from he fundamental, depending on the Q of the circuits concerned. If we llowed a 2-1 margin on this figure, 16 microsecond rise time might e thought reasonable as a test requency, at least for the purposes f gaining information on circuit ehavior.

This type of calculation is not enirely valid, as multiple wave-forms lo not add in such a simple fashion, ut it will do to indicate a line of hought.

Maybe we could resolve the probem by attempting to cut a square ave with a short rise time and laying it back with a low distorion pickup. This would at least relate the steepest wavefront we are ikely to experience in practice with ur testing methods.

So far I have not been able to ersuade our local recording engineers to undertake the preparation f such a record. It would, of ourse, include any ringing effects nherent in the cutting head, and hese might be quite appreciable. But even this information would be xtremely valuable in supplying some f the answers we are seeking.

Incidentally the best pickups today re given extremely low distortion igures. I have one for which .2 er cent. is claimed, and it sounds ood enough to substantiate such a laim. It would almost certainly e good enough to reveal deficienies in processing the record.

TOO STRINGENT?

It might be, therefore, that our quare wave tests are too stringent o form a basis of amplifier comparison. The fact that a commercial design shows pronounced ringing and restricted frequency band as compared with a good Playmaster might mean than on instruments it is inferior, but in practice, where the waveforms encountered impose less stringent conditions, it might show up equally as well.

Nevertheless, it is inescapable that the better amplifier will be the one which will most successfully pass the stringent test, provided that its cost is equal or lower.

It would seem desirable to use a transformer with as few resonances as possible, preferably of such a nature that the main peak can be dealt with leaving a good frequency curve up about 200 Kc. This should mean that no ordinary transient is likely to set up ringing. A smooth roll-off after the peak has been passed, with as few discontinuities as possible, will ensure that the feedback does not run positive and cause oscillation. Even the movement of a decibel in this region may be enough to cause trouble.

But it would be better to reduce this type of response, even drastically, rather than to operate the amplifier with severe ringing, or with the possibility of oscillation on sharp transient peaks.

In addition to the fairly straightforward phenomenon of ringing, which is merely the damped oscillation from a resonant circuit, there is a condition generally known as "overshoot."

Overshoot shows up as a sharp peak at the commencement of a square wave which is damped so quickly that it has scarcely any development at all as compared with the ringing phenomena.

It is most probably due to failure of the feedback voltage to take immediate effect at the commencement of a steep wave-front, due to the time lag in the amplifier — including the feedback loop.

It is hard to imagine overshoot appearing in an amplifier without some resonant condition which permits the voltage peak to occur, and frequently when we are successful in removing appreciable ringing from an amplifier, evidence of the overshoot will remain at the commencement of the flat top.

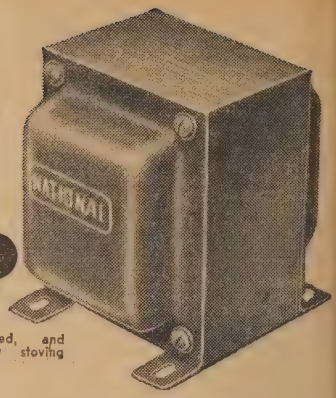
UNBALANCED WINDINGS

Frequently it will be seen at the commencement of a vertical trace in one direction, but not in the other. In fact we have sometimes seen overshoot actually subtracted from the trace in one direction while appearing in pronounced form on the other. This presumably indicates a resonant condition being picked up in only one half of the primary due to an unbalance in electrical characteristics.

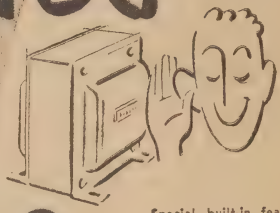
A phasing capacitor might remove the conditions from both sides of the trace, while having no effect on any additional evidence of ringing on both sides, indicating the operation of two distinct phenomena at different frequencies.

It is fairly common to observe ringing with no appreciable overshoot, but not to observe overshoot

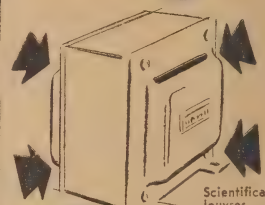
essential features



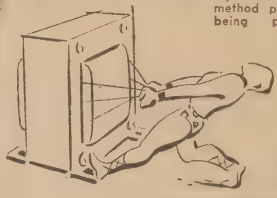
1 Attractively finished, and coated with grey stoving enamel.



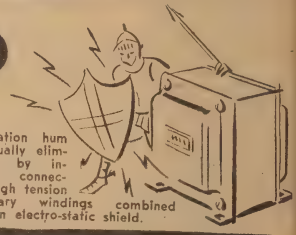
2 Special built-in features have completely eliminated lamination hum.



3 Scientifically placed louvres permit up draughts of cool air past windings, thus ensuring lower working temperature and added safety.



4 Special anchoring method prevents leads being pulled out.



5 Modulation hum is virtually eliminated by inversely connective high tension secondary windings combined with an electro-static shield.

6 Coil is impregnated with special varnish and baked to resist humidity.

7 Available in an unexcelled range of upright and flat types between 40 and 175m. for both radio and step down applications.

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with a complete absence of ringing.

The allowable amount of distortion has always been the matter of keen debate. Until recent times, the amount of distortion in a good amplifier was so much less than either the signal source or the loudspeakers that considerable latitude was in order.

Today the position is changing, but it still appears possible to reach figures which might well be so low as to be lost in the overall picture.

DISTORTION

It is hard to discuss one type of distortion without mentioning others, for in many ways they are closely inter-related.

Inasmuch as it is possible to separate them, intermodulation distortion is the most objectionable. It is caused by the non-linear characteristic of some part of the amplifier, and creates a chain of sum and difference frequencies which were not present in the original input signal.

Its presence on complex waveforms is particularly severe, and with wide range equipment it is detectable in extremely small amounts.

Total Harmonic Distortion bears a relationship to Intermodulation, although possibly not a constant one. At moderate proportions of full output it is often estimated as being about 25 pc of the latter.

Many listening tests have been carried out to determine the amount of distortion which can be detected. It is certainly more apparent on pure tones than on complex tones and must be considered a highly variable factor.

However, Olsen has shown that with a very wide range system about .5 pc can be detected on music and about 1 pc on speech, figures which were approximately doubled for a system with a 10 db attenuation at 4 Kc.

If these figures mean anything, a very high-grade amplifier we have seen would pass muster, as most of them will show much less than 1 pc. Some will give full output with as low as .1 pc.

NOT A PROBLEM

It would seem, therefore, that provided care is taken in the selection of valve operating characteristics and grid input voltages in particular, distortion is not a major problem.

In fact, it is hard to justify very large amounts of feedback to obtain extremely low distortion unless this is possible without prejudice to good square wave response and overall stability.

It should be remembered, also, that not all the distortion represented by a total figure is objectionable.

A small admixture of second harmonic distortion, which is equivalent to adding the octave, is hardly likely to degrade the output or even to be noticed. It is the thirds and fifths which are probably most important, and these would represent only a portion of the total figure. In this respect, the drastic reduction of third harmonics by using an U-L circuit are worthy of special note.

It is probably reasonable to assume, therefore, that any amplifier which shows a total distortion figure of below 1 pc over its useful range would sound well.

It is always desirable to reduce any kind of distortion to the lowest possible figure, but when we begin to observe it in small fractions of 1 pc, it is more profitable to ensure other requirements are met before reducing it still farther.

Power output can only be assessed in terms of proposed operating level. It is not possible to be dogmatic except to say that there should always be enough reserve to handle possible peak outputs as related to some average level. We should, however, consider a high-grade amplifier as being capable of being run at very loud volume without reaching its limit.

POWER OUTPUT

Probably the only way to relate average and peak output values would be by measurement, assuming we could agree on what was an average value.

To some extent the problem solves itself, for once we have agreed on a push-pull amplifier it is hardly worth while building anything below 10 or 12 watts, and often just as easy to go as high as 17-20 watts.

There is everything to be gained by doing so. An average output of 5 watts would represent very loud listening when fed to an efficient speaker system, and 15 watts would represent a margin of 30 times for peak accommodation. We believe this could be reached with modern recordings, and might even be exceeded. Indeed some figures put forward greatly exceed this estimate, although, on the other hand, some do not.

But it should be remembered that if we accept an increase of 3 db as being the smallest appreciable increase in power, it requires twice a given output to achieve it.

Distortion invariably is lower the further from overload point the amplifier is operated. For this reason, a good amplifier should show as nearly the same output over the audible range. We have tested many otherwise good transformers which showed a pronounced drop in maximum output at 15 and even 10 Kc. This can only endanger the quality of peaks and transients which invariably involve the upper audible frequencies. A substantially flat power curve between 30 cycles and 15 Kc is something we should look for, but do not always receive.

LINEARITY

Linearity—input voltage plotted against output power—and speaker damping—the ratio between effective output impedance and voice coil impedance—are generally well looked after in modern amplifiers.

Invariably these use either triodes, or more recently ultra-linear circuits, and both will produce very good figures with about 20 db of feedback. Many claims are made by some designers for the use of positive feedback to obtain what is termed complete damping for loudspeakers, but not only are these claims open to some doubt, but they appear extremely risky to use if oscillation and speaker damage are to be avoided.

From this discussion it is possible to suggest some standard of

(Continued on Page 126)

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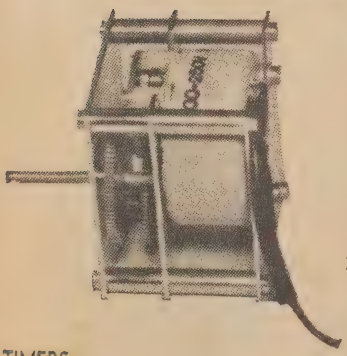

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PART THREE—CATHODE—RAY PICTURE TUBES

Modern high-definition television has only become feasible because of the development of successful cathode-ray (or electron beam) camera and picture display tubes. In this article we explain the basic principles of the cathode-ray tube and how it has been developed for use in television receivers.

WE have already seen how the early mechanical television systems achieved the necessary scanning operation by passing light through an aperture in a revolving disc or a travelling film, or yet, again, by reflecting it from a series of inclined mirrors.

The original scene was scanned—or analysed—by such means in the first instance, then the process reversed at the receiving end to constitute a corresponding image.

MORE LINES

We have also seen how the need for better picture definition made necessary to increase the number of lines and the picture repetition rate to a point where mechanical systems became largely impractical. Size, noise, and maintenance problems were out of all proportion to the results achieved.

Engineers realised that, if progress was to continue, it was necessary to dispense with mechanical devices altogether and resort to electronic methods, both to analyse the original scene and to reconstruct it at the receiving end.

The latter proposition presented no special difficulties, since the principles of the cathode-ray tube were known to early television workers. They were fully aware that a beam of electrons could be made to produce a spot of light by having it strike a suitable fluorescent coating at the end of a display tube.

They were also aware that the beam could be deflected by magnetic or electrostatic means and its intensity varied at the same time. These were the three basic requirements for displaying a television image, and the job of producing successful picture tubes was largely one of development from known principles.

How to analyse a picture by electronic means posed a more difficult problem, which was nevertheless solved in fairly short order. We shall have something more to say about television camera tubes in a future issue.

Right now, the first job is to explain the theory of a simple cathode-ray tube and its development into the rather ambitious picture tubes currently used in television receivers.

Figure 17 illustrates the development of a cathode-ray tube from first principles.

Sketch (a) shows a simple diode, in which electrons from an emitting surface are attracted to a positively charged plate or anode.

ELECTRON STREAM

In sketch (b) a hole has been left in the centre of the anode, and it will be noted that some of the electrons, due to their initial velocity, pass right through the hole and cascade into the evacuated space beyond the anode.

Those having the highest velocity may actually strike the surface of the glass envelope, as indicated.

In diagram (c) an additional cylindrical electrode has been placed around the emitting surface. This tends to confine the electron flow into a beam. If this beam is then aligned with the hole in the anode, a larger proportion of the electrons emitted will flow through the aperture, ultimately striking the glass envelope beyond and dissipating their energy in heat.

However, if the inside of the glass envelope is coated with a suitable material, it will fluoresce under the impact of the electrons. In other words, the energy of the electrons striking the fluorescent coating will be changed into visible light.

COLOR, INTENSITY

The color of light so produced depends primarily on coating material, while the intensity of the light depends also on the material, and on the number and velocity of the electrons striking it. Fluorescent lights are an everyday example of the phenomenon.

That is the first part of the story. In practice, it is necessary to produce something much better than the poorly defined blob of light which would be produced by the simple electrode structure suggested in figure 17c.

A very small but intense spot of light is required, capable of substituting for the light spot, in a mechanical TV system, which passes

Figure 16: A giant television picture tube, manufactured in Britain and having a diagonal screen measurement of 27 inches. Contrast this with the 913, a midget cathode-ray tube having a screen diameter of less than one inch and an overall size about the same as a metal 6L6.

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rough a small aperture or is re-
cted from a critically adjusted
irror.

More effective means must be pro-
ided, in other words, to "focus"
e electron stream into a fine beam,
nverging at the point where it
ikes the fluorescent material. Pro-
sion must also be made to modu-
e (or vary — the intensity of) the
am at the required rate, then to
flect it in various directions and to
ovide a fluorescent surface (or
reen) of suitable shape and dimen-
ons.

On this screen the image will
timately be displayed.

Some early types of cathode-ray
be relied for beam focusing on
e presence in the envelope of a
all quantity of inert gas.

Electrons streaming from the elec-
ode structure would collide with
oms of gas and create slow-moving
sitive ions. These ions tended to
ncentrate near the centre of the
am, causing it to converge by
ason of their attraction for the
gative electrons.

OT VERY USEFUL

While capable of operating on
wer voltages than high vacuum
bes, gaseous display tubes are of
) practical interest in television
ceivers. Focusing is mediocre and
one to upset by intensity modula-
on of the beam. Furthermore,
sponse to high-speed deflection is
ot precise.

Figures 18 and 20 illustrate the
sential details of practical high-
acuum cathode-ray tubes, using
ternative means to focus and deflect
e electron beam. Consider first
gure 18, illustrating the principle
electrostatic focus and deflection.

A specially-designed cathode
roduces a copious supply of elec-
ons. It is surrounded by a cylin-
rical element (G), which confines
e movement of electrons to one
irection, namely toward the fluores-
nt screen (S) at the large end of
e tube.

This so-called "wehnelt" cylinder
G) is generally referred to as the
id, and it does resemble the grid
f a normal valve in so far as it
ntrols the flow of electrons from
e cathode structure.

When the grid is at the same
otential as the cathode, it allows
relatively large number of electrons
) flow forward but as the grid is
ade progressively more negative
ith respect to cathode, it reduces
e electron supply and can actually
nterrupt it altogether.

By applying a fluctuating signal to
e grid, the density of the electron
ream can be varied (or modulated)
t a rapid rate corresponding, for
xample, to the vision signal from a
levision camera system.

RIGHTNESS

At the same time, the average
ensity of the beam and the average
ght intensity of the spot it pro-
uces can be controlled by the initial
ias on the intensity grid. In cathode-
ay equipment this adjustment is
ommonly made by a so-called "In-
ensity", or "Brightness" control.

Electrons emerging from the cath-
de grid structure do so in a rather
luggish fashion.

Immediately they come under the
nfluence of an accelerator electrode
H), which is roughly equivalent to

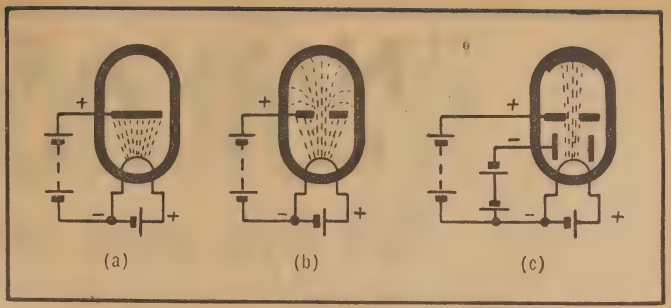

Figure 17: Illustrating the development of the cathode-ray tube from a conventional diode. Practical tubes are illustrated below.

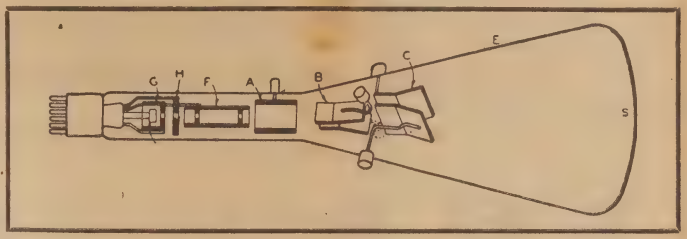

Figure 18: The arrangement of electrodes in a typical cathode-ray tube employing electrostatic focus and deflection.

the simple pierced anode of the previous illustration.

Identified generally as "anode 1", it operates at a mild positive potential. A few of the outer electrons may actually be collected by this first anode, but it is so arranged physically that most of the electrons pass through the aperture, being accelerated toward yet another electrode (F).

Known as "anode 2", this cylindrical electrode is generally operated at a higher voltage than (H), and increases further the speed of the moving electrons.

Beyond (F) there may be a third anode (A), which operates generally at a very high potential (several thousand volts). It is often connected within the tube to a graphite coating on the inner surface of the envelope and serving to supplement further the accelerating action of the whole structure.

The physical arrangement of the various anodes, and their operating potential, creates a number of electrostatic fields which operate on the electron beam in a manner reminiscent of glass lenses and light rays (see figure 19).

The "focal length" of the lenses depends on the exact potential and position of the anodes, and it is usual to make the voltage on one anode readily variable as a "focus" control.

In figure 18, this would normally be the electrode F.

As the focus control is varied, the spot on the screen will be seen to enlarge or come to a brilliant pinpoint, which is normally the condition required.

SPOT OF LIGHT

By the time the electrons pass through A, they have been focused into a well defined beam and are moving with high velocity. When they ultimately strike screen (S) they create a bright spot of light, comparable in size to the head of a pin.

While we have drawn the analogy between an electron beam and light, there is the important difference that individual electrons tend to repel one another, since they are "like" negative charges.

Thus, despite the action of the electrostatic "lens", the electron beam tends to spread of its own accord.

This de-focusing effect becomes most marked when the density of the beam is increased in an en-

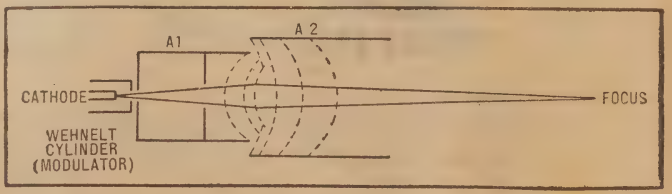

Figure 19: In an electrostatically focused C-R tube, electric fields between the adjacent edges of the circular anodes form a "lens" which acts on electrons in a manner rather similar to the action of a glass lens on light rays.

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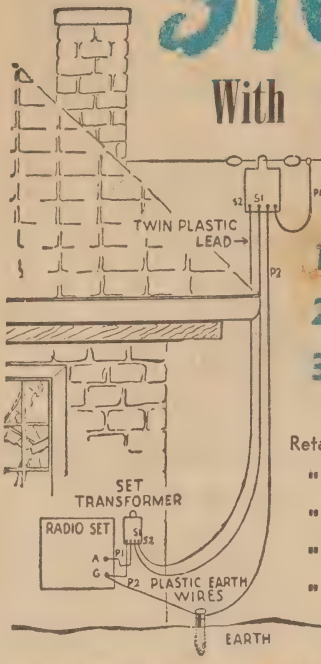

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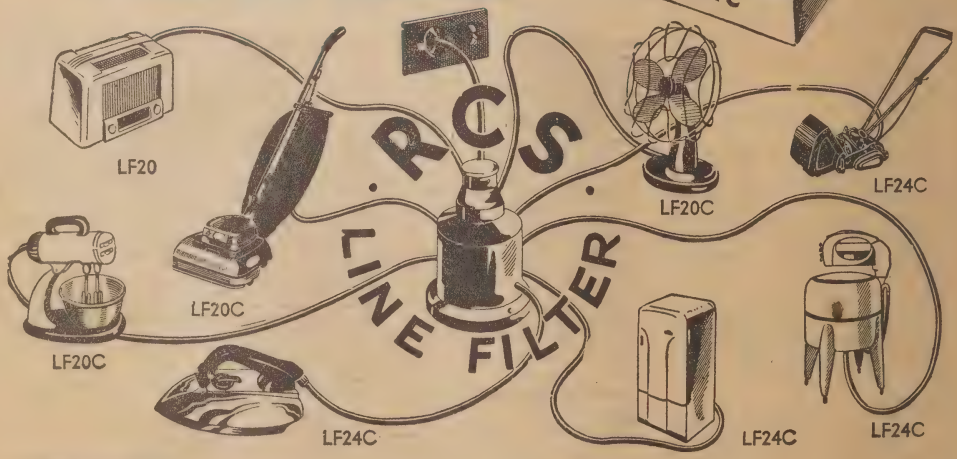

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eavor to obtain a brighter fluores-
nt spot. It can be offset, how-
ver, by operating the tube with
creased anode potential, thereby
creasing the velocity of the fly-
g electrons and making them less
nsitive to mutual effects.

This point explains why it is
ecessary to use higher, and still
gher operating voltages in a CR
be when a bright sharp image is
quired.

The term "electron gun" is com-
only employed to describe the
sic structure supplying the elec-
on beam. It varies with tube
pe but comprises the heater, cath-
de, grid and at least one acceler-
ing anode.

Although figure 18 shows three
odes of specific shape, it does not
llow that all such tubes are built
this exact pattern. The struc-
re may be more simple or more
mplex, depending on the purpose
id ideas of the designer, but the
eneral principles remain the same.

LECTRON GUN

The electron gun is an integral
art of all cathode ray devices
hether they are simple receiving
bes or more complex units in-
nded for television cameras.

It is fortunate that the current
awn by the anodes in a CR tube
very small (in order of micro-
mps), so that the power supply
rcuit does not have to handle
eavy current, even though the
oltages are high.

The exact figures, of course, vary
ith the type of tube, exactly as
o the ratings for ordinary receiv-
ng valves.

The type of CR tube illustrated in
gure 18 is said to employ elec-
ostatic focus, since it depends on
ne voltage gradient between suc-
essive electrodes.

An alternative idea is to focus
ne beam by means of a magnetic
eld as illustrated in figure 20. In
is case, the electron gun comprises
mply a cathode, a "grid", a first
node and, possibly, a graphite coat-
ng on the inside of the tube walls
cting as a high voltage accelerator
lectrode.

Electrons emerging from this
ructure pass through a magnetic
eld created by a coil wound
round the neck of the tube. The
lectro-magnetic "lens" so formed
ends to focus the electron beam,
ne focal point depending on the
xact position of the focusing coil
nd the current flowing through it.

AGNETIC FOCUS

CR tubes employing magnetic
ocus are commonly used in tele-
ision equipment, the advantages
laimed centering mainly on the
omparative simplicity of the tube
ructure and the wide angles
rough which it is possible to
eflect the beam.

To this point in our discussion
e have seen how the electron
eam is produced, how it can be
odulated and focused by one
eans or another to a fine spot.

While this is all very interesting
ere is obviously not much point
having a stationary spot of light
n a fluorescent screen. Indeed,
ne impact of the electrons would
ery quickly "burn" the fluorescent
aterial.

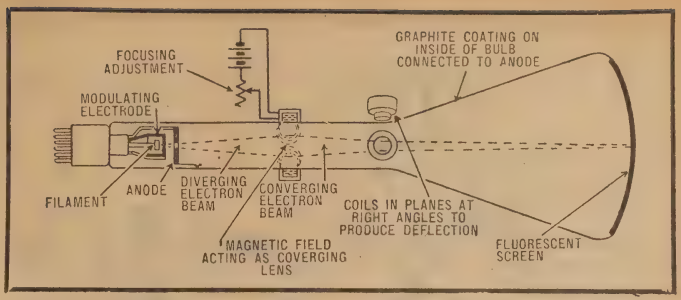

Figure 20: A typical cathode-ray tube employing magnetic focus and deflection.

What is required is some means to control the position of the spot on the screen so that it can be swept back and forth, up and down, in any desired fashion.

In other words, the electron beam must be induced to perform the function of scanning, exactly as in the mechanical systems we have already examined.

The desired result can be accomplished in two ways, namely, by electrostatic or by electro-magnetic "deflection".

The principle of electrostatic deflection is assumed in the illustration, figure 18. Two pairs of flat plates shown as B and C are mounted in front of the final anode (A). Their initial d-c potential is normally the same as (A).

The electron beam passes between each pair of plates, which can be connected to an external source of signal.

If, at a particular instant, one plate of a pair is more positive than the other, the electron beam tends to be deflected toward the positive deflector plate. At the next instant, the position may be reversed and the electron beam deflected the other way.

Thus it becomes possible to swing the beam to and fro and, with it, the resulting spot of light on the screen.

By having one pair of deflectors vertical and the other horizontal, it is possible to swing the beam simultaneously to and fro and up and down as required.

In other words, the cathode-ray beam can be made to fulfil the requirements of a scanning system by providing suitable control voltages on the deflector plates.

BEAM DEFLECTION

As an alternative, the electron beam can be deflected as required by locating magnetic coils around the neck of the tube in front of the focusing coil. These are illustrated in figure 20. We need not worry overmuch at this stage about the exact shape that such coils take, the important thing being to grasp the principle involved.

Although the drawings show valves with a wholly electrostatic

(Continued on Page 118)

Figure 21: Assembling the "guns" of Mullard television picture tubes. Note that the gun structure is bent, the intention being to prevent heavy ionised atoms from striking the screen along with the electrons and causing ion "burns".

Let's Buy An Argument

This month, a letter from a New Australian reader raises a subject which, according to other members of the R, TV & H staff, is one very dear to my heart. There's a saying round the place that, if "WNW" has anything to do with a design, it's sure to include some fancy tone control system!

by Neville Williams

I STOUTLY deny it, of course. We've featured in the past a whole series of multimeters and grid-dip oscillators and not one of them has ever had any provision for bass and treble boost!

But, setting aside the implied insult, I suggest that you read the letter in question, in the panel on the opposite page. Only the relevant portions have been quoted, retaining much of the original phraseology by way of "atmosphere". As you will note, our friend is a Dutchman, facing the difficulties of a technical subject in a new language.

DO THEY MATTER?

His key question is the third one, relating to the possible effect on listening of frequencies above and below the normal range of sound. Are they significant?

If they are, what account do we take of them in planning tone compensation networks?

Why do our curves show only the response of such circuits over the audible range?

In trying to answer these questions, I don't want to steal the editor's thunder, because he is pre-occupied at the very moment with the possible impact on the listener of subsonic and supersonic frequencies —particularly the latter. My remarks here must, therefore, be framed with this in mind.

It is quite true that the vast majority of compensation curves, published by this and other journals, are confined to the audible range, extending nominally from 20 to 15,000cps. We do this on the simple assumption that only the audible frequences matter, as far as balance and compensation are concerned.

The lowest organ note ever produced or recorded is allegedly 16cps, but, in actual fact, the bass response of most program material would end a full octave above this. Therefore, to sustain response and compensation down to 20 cycles would appear, on the surface, to be generous.

At the other extreme, our normal "hearing" process fades out at about 15Kc, and it is commonly assumed that there is no justification for worrying about response over this approximate limit. We wouldn't hear the result anyway! We would remain blissfully ignorant, whether the response was sustained there after, or drooped away by reason of circuit losses.

In point of fact, it isn't hard to demonstrate that we do have some response to supersonic energy. A speaker projecting moderate power into a room at say 20Kc cannot be "heard" by most people, but it can rapidly produce a conscious degree of nervous tension and fatigue.

NOT DEFINITE

Whether the small, transient supersonic energy contained in everyday sounds is sufficient to produce an appreciable stimulus is problematical. Some are beginning to think that it might, but it's a pretty tentative kind of postulation.

To date, it hasn't been sufficiently strong to warrant specifying the performance of tone compensation circuits outside the limits of hearing. Until enough strong evidence comes to light, I guess that our tone compensation curves will continue to look much as they have done in the past.

That doesn't mean, of course, that we ignore the response of an amplifier system outside the limits of hearing. Once upon a time we might have done so, but not now. We've learned that the response at extremes of the range is important anyway, for other than musical reasons.

STABILITY

As the editor points out elsewhere in the issue, the extent and shape of the main amplifier response in the high frequency region governs the stability of the system and its reaction to transient pulses. Careful study of the main amplifier in this region is warranted, therefore, if only to guard against producing a design which will go into supersonic oscillation at the drop of the proverbial hat.

If it is shown that an extended

smooth response into the supersonic region is also essential for musical realism, then some of the attention being currently paid to basic amplifiers will have to be transferred to earlier links in the chain.

Recording engineers will have to look to their laurels, pickups will have to undergo yet another revolution and control units will have to start borrowing from video techniques. All the well-known recording curves will have to sprout "extensions" along with their complementary playback curves.

But the game is hard enough already, and, until somebody proves the necessity for the more elaborate approach, I can't see too many designers adopting it.

Right now, the most obvious effect of extending the input circuit response would probably be to render the whole outfit inordinately sensitive to switching transients in the house wiring—and that isn't a good thing.

BAD FOR NERVES

It's just amazing how "electrifying" 15 watts of "plop" can be, emanating from a big speaker in the dead of the night!

Of course, this tendency could be minimised in turn by building in an effective line filter, but there we go again—complicating the equipment to counter some previous complication that may not have been necessary anyway!

At the other end of the range—below about 20cps—the shape of the response curve has a lot to do with the tendency of the system to "motorboat" and its sensitivity to motor rumble, cabinet vibration and so on. It must, therefore, be considered.

A classic example of this fact was provided by the basic Williamson amplifier which, by reason of a peak at about 2cps, was extremely prone to motorboating troubles, when extended to include a preamplifier and tuner, operating from the same power supply.

It led us into extensive decoupling systems, voltage regulation and the final abandonment of the circuit as "too hard" for the average home constructor.

THE "PLAYMASTERS"

On the assumption that a response to less than 2cps was unnecessary and, in fact, a bad thing, we introduced the "playmaster" series of amplifiers and tuners. Their acceptance is now history, for they provided all the bass response that could presumably be justified, with no serious stability problems.

There are some who contend, of course, that it isn't good design to operate a complete amplifier system from a common power supply; that each unit should have its own power supply irrespective, duly filtered and regulated!

This is a rather extreme view, I fear, having its strongest supporters among those who can afford it.

Profligate use of parts can actually amount to BAD design, if it is made necessary by some undesirable or reduntant characteristic or if it fails to contribute anything useful to the prime function of the equipment.

But, maybe, that's asking for an argument on another subject.

ABOUT TONE CONTROL CRICUITS

I have a few questions about tone controls, which you might like to answer in your "Let's Buy An Argument" pages.

You draw a nice diagram covering the audio range (30cps to 15Kc) and that is all. Is it ideal to stop at 15Kc or is it needed to go much higher?

Most circuits drop in the extreme bass and treble but some systems go higher than 20 or 30Kc.

Can you suggest what happens when you get boosting under or above the limits of hearing; does it affect the normal sound?

One well known tone control system is of the resonance type with peaks at 30 cps and 10Kc, giving a sharp peak of up to 20db with a roll-off beyond it.

And what about the cut-off in the treble? When you have a sharp filter, it does not sound nicely. The one I heard was in a voice coil filter. The ordinary roll-off control that is used sounds nicely.

Now my letter is possible not clear at all. Will or can you please give me the needed information if it is possible? ("Will" in Dutch means asking someone something, not "must").

Yours Faithfully, N.F.G.

Whether or not there is any virtue in achieving a DC-like bass response, the undeniable fact remains that an extreme downward extension of the frequency range does multiply the chances of the speaker cone flopping around with rumble from the turntable, imperfections in the record and vibrations from the floor and cabinet.

Even if the cone movements aren't immediately audible as "sound", one can still be aware of them and, in any case, there is the chance that they will modulate the normal bass content of the programme.

To avoid such troubles—or rather minimise them—the usual course has been to let the response fade away below about 20cps, even making some effort to see that it is not sustained into the region where motorboating and rumble problems predominate.

PLAYBACK CURVES

For this very reason, the AES playback curve has given place to others which allow a flattening off below about 25cps and do not call for circuitry which almost "guarantees" that the channel response at 10cps will be higher than it is at 20cps.

But if, in turn, an extension into the subsonic range is shown to be necessary, then we'll have to solve a few more problems. Truly rumble-free motors will have to be made, pickups without obvious arm resonance, even better output transformers and, of course, bigger and better speaker systems.

In the face of all this, the elongation of a control unit response curves wouldn't be an insuperable problem. But, of course, along with the recurring need for higher gain, it might push us beyond the limit that we're already approaching, where stable operation from a single power supply is impractical.

This statement brings us back almost where we started. But why worry? This is an argument, isn't it?

Then N.F.G. raises the question of using compensation circuits built around resonant chokes. Well, what about them? Are they good or bad?

My first encounter with resonant type compensation circuits occurred when I was a mere youth, which is a roundabout way of saying that it's a pretty old scheme.

As I remember at the time, the two resonant chokes, each shunted by a variable resistor, were connected in series in the plate circuit of an early pentode voltage amplifier. Included in the circuit was a resistor of a few thousand ohms to provide a permanent plate load for the valve.

BOOST EFFECT

With the pots. at minimum resistance and the chokes shunted out, the response was level. Removing the shunt from either or both chokes allowed them to develop their respective peaks, giving bass or treble boost as desired.

I remember being quite impressed at the time by the effectiveness of the system. I also remember that the words "Bass" and "Boomp" were practically synonymous in those days and no one was unduly perturbed about the resonant nature of the circuit. If it produced plenty of boomp, then it had a good bass response. That was the end of the matter!

Nowadays, high-fi fans do their level best to avoid such resonance, either in the amplifier itself or in the speaker system. They resort to negative feedback, special cone suspension and to anti-resonant baffles. The object is to retain maximum control over the speaker cone at all times and to prevent it from developing a damped wave train every time it is hit by a substantial low frequency signal.

I remember being impressed also by the performance of the resonant control at the top end of the range, but, of course, this was a long time ago, in terms of audio development.

Microgroove records didn't exist, pickups cut off well below 10Kc and wide-range speakers were rather futile curiosities. It was quite a novelty to turn a knob and hear the sibilants hiss at you.

But, of course, the novelty angle of treble, as such, has gone and the emphasis is now on true treble, clean and non-peaky. Over-prominent sibilants indicate failure, not success.

AVOIDING PEAKS

We still have a lot to learn about the subject but, among other things, modern practice is to try to minimise circuit "ringing" and to avoid peaks in the response, which noticeably "color" the reproduction and emphasise record noise.

With this end in view, designers of high quality pickups take great

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X Plate Sensitivity	.14
Y Plate Sensitivity	.33

Anode 3 1200 Volts
Electro-static deflection
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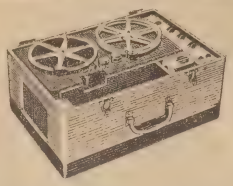
Socket connections can be supplied to each purchaser.

Price 32/6



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19	100	CT	6/-
20	50	Variable	4/-
36	100	None	6/-
45	100	None	6/-
50	10	None	1/6
50	20	None	2/-
60	60	CT	5/-
100	40	None	4/-
100	50	Variable	4/-
120	80	None	5/-
150	20	—	2/-
200	100	Variable	6/-
250	50	None	4/-
300	85	None	5/-
350	25	Variable	2/6
400	50	Variable	4/-
430	200	None	8/-
500	27	—	2/6
500	100	—	6/-
700	20	—	2/-
850	20	—	2/-
1000	100	Variable	6/-
1000	150	CT	7/-
2000	75	Variable	5/-
2000	150	None	7/-
2500	10	—	1/6
2500	20	—	2/-
2500	50	—	4/-
3750	30	None	3/-
4000	20	—	2/-
5000	20	—	2/-
5000	40	—	4/-
5500	12	—	1/6
10,000	55	3000	4/-
10,000	50	None	4/-
15,000	50	Variable	4/-
25,000	30	None	3/-
25,000	40	—	4/-
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50,000	80	—	5/-
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11. **Gramo Motors.** Single speed, reconditioned and guaranteed in working order. Each motor has magnetic pick-up and automatic stop. **Price only £2/17/6 each.**
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18. **Phone Jacks.** Closed circuit P.M.G. type. Brand new. **2/6 each.**
19. Low Impedance Headphones British manufacture, new and boxed. **Price 18/6 each.**
20. High Impedance Phones, made in Germany, light weight, excellent quality, adjustable. **Price 39/6 each.** Brand new and boxed.
21. 2 Valve Amplifiers, type A1134, less valves. Components in each amplifier, 1—8 pole PMG switch, 3 position Toggle, 1—2 Way Toggle Switch, 4 Transformers Audio, Input and Output. A number of resistors and condensers, all in metal box. 6¾in x 4¾in x 4¼in. **Price only 10/6 each.**

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pains to push any peak as far up the range as possible and to damp it as much as possible, so that it will have a minimum effect on the end result.

Peaks in the speaker system are regarded with grave misgivings.

In the face of all this, to introduce a resonant circuit in the guise of tone compensation, appears clearly to be a retrograde step. It is much safer to use a simple R/C circuit, which takes up and rolls off gradually and does not normally produce a slope exceeding 6db per octave.

If it is of any comfort, it gives the same kind of compensation curve as is common throughout the audio industry.

Chokes can make sibilants hiss-at-you,
Trace CRO patterns charmingly Lissajou;
But transient pinging
Is turned into ringing
And ends up a horrible zizzi-goo!

Besides that NFG, chokes are costly and they pick up hum feet away from motors or transformers.

NOT MUCH USED

They've had their day, I fear, except for very special purposes, such as teasing the last ounce of treble from badly copied 16mm sound films.

But you wouldn't call that audio! Well hardly.

Perhaps this condemnation of resonant compensation circuits does not seem to tie in with our erstwhile sponsoring of voice coil filters—which are obviously of the resonant low-pass type. This is probably the situation that NFG anticipated when he raised the subject. Are we being inconsistent?

I just wonder about his statement that a sharp cut-off filter does not "sound nicely". Is he conveying the wrong sense or is he basing judgment on some amplifier-filter combination which is ringing badly for one reason or another. Such ringing can be very unpleasant, amounting almost to an echo effect.

NOT OBJECTIONABLE

I can assure NFG that the R, T and H filter does not (or should not) sound like that. To be sure it changes the character of the reproduction and record noise in a most obvious fashion and it takes a few moments for the ears to grow accustomed to the change in frequency content. But the end result is never positively objectionable. When the filter is justified, its use always makes the program more listenable.

To appraise the filters properly, one must appreciate why they were suggested in the first place.

We've been through this before, but the story, briefly, is this: Many readers bought wide-range speakers when they were first introduced and attached them to their pet amplifier systems. On the new microgroove records, which were then just appearing, the speakers sounded excellent, while they were quite good also on radio.

This was all to the good, but the rub came when the enthusiast tried to play his ordinary 78 records through the system. Quite apart from sounding dull and noisy, which could be expected, the reproduction suffered from a most objectionable distortion on high frequencies not unlike the buzzing effect of a loose turn on the voice coil or some such speaker fault.

The trouble was due in part to the record grooves, in part to stylus problems, with the general imperfections of the pickup, the amplifier and the speaker itself thrown in for good measure.

We had to face up to the problem, like everyone else.

Conventional tone control measures, giving a slow roll-off, didn't prove to be a good answer because, to be effective enough at the top end, the roll-off cut unnecessarily into the middle register. The contrast with good, wider-range reproduction was rather appalling.

In due course, we got around to the sharp-cut voice-coil filter idea and it provided the kind of answer we were looking for. The sharp roll-off proved very effective against the distortion we were worried about, while having a minimum effect on the usable portion of the range.

EMERGENCY MEASURE

But don't get us wrong, NFG. A sharp cut-off resonant filter is not a good thing in its own right—but then neither is the kind of noise and distortion against which it was designed to operate. It is a clear case of the end justifying the means.

Nowadays, the pickup and record position has improved to the point where at least the more affluent quality fans can pick and choose between records and pickups to guarantee a more nearly distortion-free input signal.

For such folk, a voice coil filter unit is unnecessary.

But where one cannot be so discriminating, or where one wants to draw on an existing library of 78 rpm records, or where static or line noise is a problem on occasions, a sharp cut-off voice-coil filter is a handy thing to have at the end of a switch knob.

Maybe it does amount to curing one evil with another but, if the end result is more acceptable, what of it?

And what if the filter does ring on square-wave input and what if it does appear to have a 2db bump before the roll-off? Wouldn't you rather put up with these second order effects than the horrible scratchings and buzzings that emanate from a wide-range system reproducing distorted programme material.

I would, any day!

In conclusion, N.F.G. says that an ordinary roll-off control "sounds nicely". Once again I'm wondering whether it is a matter of phraseology or whether he has failed to appreciate the purpose of the circuiry in question.

WRONG IDEA

Perhaps he has fallen into the same trap as another reader who spoke to me recently. This reader was trying valiantly to use a top-cut filter in the voice coil circuit to compensate for microgroove pre-emphasis.

Actually he didn't quite realise what he was trying to do, but that's what it amounted to. His amplifier was an old style affair to which he had attached a modern crystal pickup.

The few microgroove records he had purchased naturally sounded "rather thin" on the outfit, both because they contained an unaccusomed amount of treble and also because this treble was pre-emphasised in accordance with normal microgroove practice.

The reader concerned could largely have corrected the situation by turning his tone control down a little but this he was unwilling to do on the grounds that he did not want to "throw away the treble response".

TOO EASY!

Furthermore, it didn't seem right that a terribly technical operation like providing de-emphasis could be accomplished by simply turning back a tone control knob.

Accordingly, he had gone ahead and built up a voice coil filter unit. This had allegedly improved matters but he felt that the balance "still wasn't right".

He took quite a bit of convincing that his approach was completely wrong; that he wasn't throwing treble away by using his tone control as suggested, because the records were cut with exaggerated treble which actually required to be attenuated during playback.

By not using his tone control as suggested, he was allowing the overall treble response to rise, in accordance with the pickup and recording curve, toward the region where the filter operated. This removed all frequencies above the roll-off region, so that the overall curve was quite peaky.

The result would inevitably be a rather strident kind of reproduction, lacking really high frequencies and exhibiting a rather prominent noise level.

He agreed that this was, in fact,

(Continued on Page 119)

TRANSISTOR SET

Dear Sir:

I have been interested for quite some time in building a transistorised radio receiver, but have had trouble finding a suitable circuit. I had decided on a four transistor set suitable for a car radio, and the other day I discovered your article in Radio Television & Hobbies of August this year so I decided to use that circuit.

There are a few points that I would like a little extra information on. Firstly, the driving transformer for the push-pull stage—are there any suitable transformers on the market? If not, how many turns of what gauge wire are required with what type of core? (Size is not particularly important.)

Next the speaker—I am thinking of using a 7in X 5in oval one with as near to 2 ohms impedance as I can get, so what type of transformer is used with that? Lastly, how is it possible to modify this circuit for either 6 volt or 12 volt operation?

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See the full range of new machines at Magnetic Sound. New model "Elcon" (above) is a radio-recorder with 7 valve radio input, £140 or £25 dep. "Tecnicorda", (right) gives 2 hours recording and is ideal for home movies, £149/2/-.

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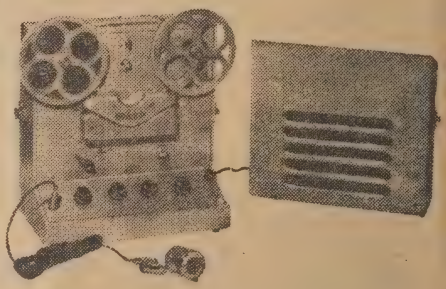

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Here at last! The revolutionary time clock that, once set, will automatically switch on any tape recorder or radio, then when the programme or item is finished, automatically turns the power off! Now you can record any programme while you are out . . . even while you're asleep! Makes a handsome and accurate electric clock when not in use. £12/17/6.

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Special: B.A.S.F. to clear, 7in reel, 1200ft usually £3/15/- now £2/5/-
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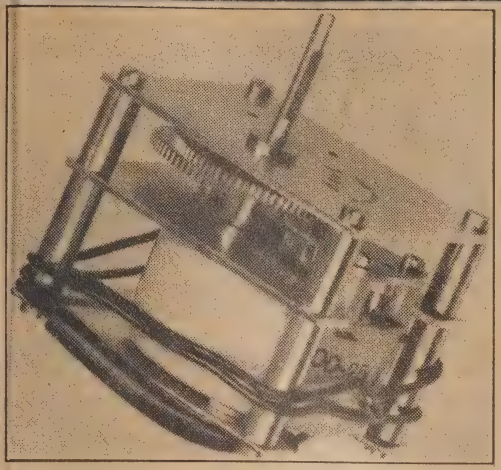
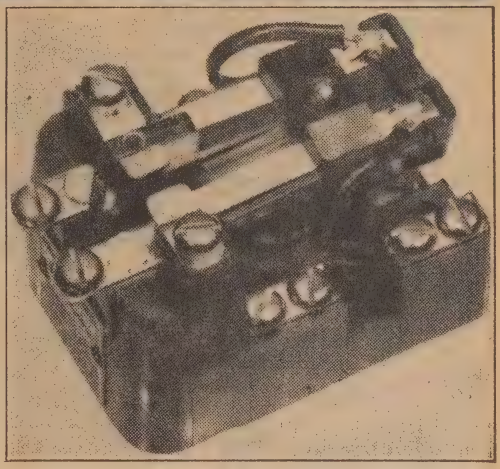
TRADE REVIEWS AND RELEASES



Small synchronous motor with gear train reduction for driving window displays etc.



A two-pole changeover relay, AC operated Cat. No. 28308U. Other types can be supplied if required.

FLASHERS, RELAYS FROM PAYNES

From a large range of electronic equipment, R. J. Payne & Co., of 434 Collins St., Melbourne have submitted a number of items for review.

THESE include a well-made and powerful synchronous type motor, suitable for many purposes, including the operation of revolving advertising displays, etc.

This motor is claimed to have the highest torque of any similar type available, and can be supplied ex stock in 1, 6 or 10 rpm.

Another line handled by Payne's is represented by a change-over relay, AC operated, and with sturdy contacts for heavy loads. The relay is built on a bakelite body with an adjustable spring loading. Made by Arrow of Sydney, it is obtainable in a variety of types. The base measures 2-11/16ths by 1-7/8in.

"Payneco" products include a large selection of flashing and timer units for various purposes. One of these is a bayonet adaptor into which is built a flasher which operates at about 12 flashes per minute. It is suitable for lamps up to 100 watts, AC or DC.

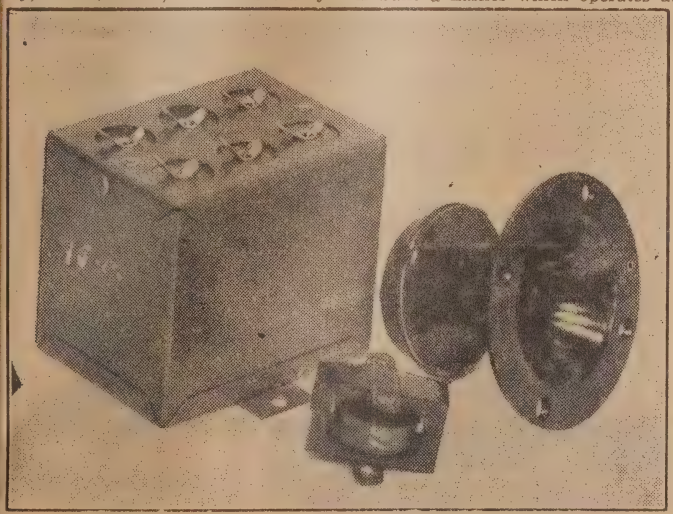
A similar flasher unit is available as a separate item.

Another type of flasher is designed for 6 or 12 volt operation to handle 6 amps AC or DC, particularly suitable for display work and automotive turning indicator lights. Different types can produce either 40 or 80 flashes per minute.

Larger motor driven flashers can be supplied to accommodate multiple globes up to 2400 watts.

Paynes are also distributors for Solartron British-made test equipment including wide range oscilloscopes, oscillators, pulse generators and regulated power supplies. These are all high quality products, specifically designed for laboratory work where modern electronics is concerned.

T. J. Payne will be happy to send details on any of this and other equipment on application.



The Ibbott tweeter cross-over network and coupling transformer.

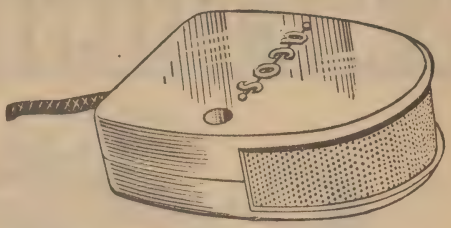
IBBOTT CRYSTAL TWEETER

An interesting, Australian-made crystal type speaker for audio work is the IBBOTT tweeter illustrated at left.

IT comes complete with matching transformer and cross-over network for connection into a 15 ohm output circuit. Suitable networks are available for operation from both 15 and 2 ohm sources.

The frequency range is given as 2500-20,000 cycles with a dispersion angle of 60 degrees.

Used with a bass-middle speaker in a vented enclosure, the tweeter sounded very good. It has a commendably smooth response which appeared to hold well to at least 14 Kc. Its small size could be a great advantage in many cases.



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ACOS MIC 35 (HAND AND/OR DESK TYPE)

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Provided with built-in shunt resistance of 2 megohm giving response substantially flat from 50/5,000 cps. Resistance of the input circuit will reduce the low frequency response. A grid leak of ½ megohm will reduce the output at 500 cps by 3 dbs and pro rata at lower frequencies.

Approximate capacitance of the microphone is 750pF and cable capacitance will reduce output proportionately.

Frequency response	Substantially flat from 50/5,000 cps.
Output level	≅ 55 db ref. 1 volt/dyne/cm2.
Load resistance	2 megohms included.
Cable	This microphone is supplied with approximately 4ft. 1.2 metres of co-axial cable (type Unirad 32).
Weight	Microphone only — 6oz. (approx. 170 grammes) complete with packing 7oz. (approx. 198 grammes).
Dimensions	Microphone only 2 7/8in x 2 1/8in x 7/8in plus cable. Complete with packing 3 3/8in x 2¼in x 2¼in

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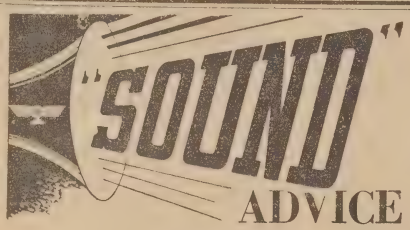

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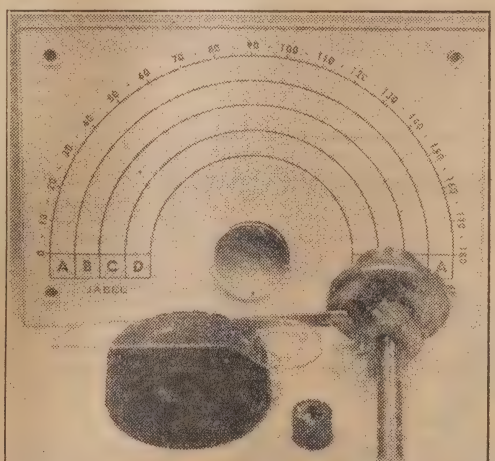

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Also available is the normal 5 to 1 planetary drive without the cursor mounting flange; this retails at 11/-. Supplies of all these items are available through the normal trade suppliers.

OFF THE RECORD — NEWS & REVIEWS

The number of recorded operas being released at present is sufficient testimony to their popularity, undoubtedly due to the long playing record. Whether many of the old timers are as successful today as in their time is a matter of opinion, but doubtless there would not be purchasers if many people did not think so.

By JOHN MOYLE

ONE hopes that it is charm of the music and not the libretto which is the main attraction, for some of the stories demand extreme feats of imagination.

One of these is I Puritani, The Puritans, by Bellini.

Not only is it sung in Italian, and scored with lush music of a type which the Puritans could scarcely be expected to countenance, but it is filled with action and characters only to be found in such fairy tales.

BELLINI—I Puritani. Opera in three acts with Maria Menghini Callas (Elvira) and Giuseppe di Stefano (tenor) and the Chorus and Orchestra of La Scala Opera House, Milan, conducted by Tullio Serafin. Columbia 33CX1058-1060.

This was Bellini's last opera, and with Norma probably the only one ever heard today.

The music is romantic in a Weberish-Verdi style with all the basses, tenors and soprano in the right places, singing tuneful arias and choruses over the six sides.

All the singers are good, with Maria Meneghini Callas probably the best. I don't think anyone will be disappointed on this score, but it is a pity the star numbers are not tied together with less stilted action.

As a recording I thought it very good, although only one familiar with a performance could really assess many aspects of it, and I doubt whether there are many such among my readers. The singers are heard well, the orchestra balances suitably, and plays throughout as though it knew its business.

The surface is virtually noiseless. I believe this is the only recording of I Puritani, but it is quite good enough not to let that worry you.

The booklet containing the full text is well presented and invaluable.

GOUNOD — Romeo and Juliette. Opera in Five Acts with Janine Micheau (Juliette) and Raoul Jobin (Romeo) and the Chorus and Orchestra of the Theatre National de l'Opera, Paris, conducted by Alberto Erede. Decca LXT 2890-2892.

The recording runs away with the honors in this release—it is Decca's top grade standard, obvious from the first few bars.

It is hi-fi stuff as compared with I Puritani, and I found the greatest pleasure in listening to it for that reason alone. The chorus I thought equally good.

The general standard of the singers didn't please me as much. It's extremely doubtful whether Gounod's lovers are intended to be in the same age group as Shakspeare's, and I couldn't persuade myself that Juliet at least was quite as juvenile. Emotionally even the Bard didn't achieve such maturity.

Much of the action, too, although sung suitably agitato, somehow didn't convey full conviction. Surely the critical swordfight should have been accompanied with some "noises off", for instance.

It's hard to avoid staginess without some visual action, and it might be a good thing for recordists to remember this when undertaking a long haul of this kind.

Once again, those who buy th opera for Gounod's music will g exactly that, and are not likely to b disappointed.

MASCAGNI—Cavalleria Rusticana with Maria Meneghini Callas (Santuzza) and Giuseppe di Stefano (Turiddu) and the Chorus and Orchestra of La Scala Opera House, Milan, conducted by Tullio Serafin. Columbia 33CX1182-3. Fourth side vacant.

This opera stands up much mor vigorously than either I Puritan or Romeo and Juliet. It is neare to the earth—nothing of the draw ing room romanticism here, bu a violent story of passion and sud den death.

Compared with the Decca releas recently reviewed, the only point i which it is inferior is the recordin

This is rounded and full, bu hasn't the impact of the Decca re lease, and at times the tempo hang a little more.

But in every other respect, it i vastly better.

Both the leading tenor and sopran to my way of thinking are in higher class. They are first rate particularly Callas, who once agai takes the honors, even mor definitely.

It is a role which I thought suite her admirably.

There are other superior point as well. Most noticeable is the bette voice of Alfio. He sings his openin aria to a most convincing accompani ment of whip-cracks which give tha "noises off" atmosphere I mentione earlier as being so important.

Having so recently reviewed thi opera. I'll say no more than this—i you want a Rusticana, this i definitely the one to buy. Being b the same company, its genera recording atmosphere is similar t that of Romeo and Juliet.

SCHUBERT—Symphony No. 8 in B minor (Unfinished). Symphony No. 5 in B flat major. Played by the Vienna Philharmonic Orchestra, conducted by Karl Bohm. Decca LXT2998.

If you like these symphonie played at a slow tempo, every phras beautifully and sympathetically turned, then you'll like this record

Personally I feel that the Unfinished in particular drags far too much when played at this pace. don't even see the music that way —it can come to life with more urgency than this. It's just a bi too much like bedtime music, particularly when the recording lacks enough weight to sustain this particular approach. The second movement fares somewhat better, but still tends to drag. There are few symphonies in which just the right pace is so rewarding.

I have the same general criticism of the 5th, although here the conductor is more successful in making his point.

Apart from this matter of tempo, the playing is distinguished and the recording clean and clear. There are a couple of obvious tape joins, one near the middle of the first movement.

In brief, OK if you are not in a hurry. Two symphonies on one disc makes good value.

The Decca curve is best with a little bass boost. The surface is good.

DEBUSSY—La Mer. RAVEL—Daphnis and Chloe Suite No. 2.. Played by the NBC Symphony Orchestra conducted by Arturo Toscanini. HMV OALP1070.

The competition for La Mer is from the recently reviewed recording for Columbia by von Karajan, and in my opinion he takes the honors. Toscanini misses that touch of mystery, that nebulous quality that Karajan achieves better than anyone else to date.

The orchestra is more forward and the parts more clearly defined, but lacks the right amount of reverberation, which is essential to tie the sound together. I don't think the greater impact of the new record is called for in this case, although it is by no means the dead atmosphere we learned to detest with many early Toscanini efforts.

In all other respects I liked this side. There is plenty of good stuff in it.

Daphnis and Chloe does much better, and, although missing some of the delicacy of the Andre Cluytens record for Columbia, gains through its more immediate recording. It lacks the chorus and the added color it brings, but the orchestra has a better chance to whip up the excitement.

Unfortunately, there is some rather obtrusive, low-pitched tape hum, which wide range machines will pick up—I'm sure it isn't in the score!

Altogether a good disc, and one of Toscanini's best all round recordings. Use the EMI setting. The surface is not perfect, but compares well.

BRAHMS—Sonata No. 1 in G major, Opus 78, Sonata No. 3 in D minor Opus 108. Played by Isaac Stern, violin, and Alexander Zakin, piano. Philips AO1143L.

Violin and piano sonatas aren't the easiest things to make sound convincing, to say nothing of the difficulties which surround a recording. Here the violinist particularly is out on his own, and with a recording as forward as this one, his every touch and stroke must be perfection itself. There is absolutely no escape for him.

In my eyes, therefore, it is a tribute to these two, and to Stern, in particular, that I became so immersed in the music that to write about it became almost an irritating intrusion.

Both performances I thought superlatively good. These are two of the finest and loveliest sonatas in the book, and they are played with an authority and musicianship of the highest order.

The recording is quite forward, although only on odd occasions does the violin take on its full edge, which many people don't like on records, and which can only be successfully handled with the best equipment.

Instrumental balance is good, and there is a fine understanding between players. It would be exceedingly difficult to find a jarring note on either side. The surface for the most part is inaudible.

To have two such performances on a single disc makes this record an automatic selection for anyone building a library of representative works.

WALTON—Facade, with Dame Edith Sitwell, and Peter Pears. The English Opera Group Ensemble conducted by Anthony Collins. Decca LXTA2977.

Facade was a product of the twenties—the very clever twenties of Noel Coward and the experimental in music and verse. Not that there isn't experiment today, but anyone who lived through that period will know what I mean, and will be able to date this extraordinary composition accordingly.

I am not competent to comment on its success or otherwise, because it isn't the kind of stuff which moves me to more than a passing interest. After one or two spasms, it all seems very elementary, despite the doggedly enthusiastic efforts of Dame Edith Sitwell, who must have been a little more lively and more interesting in 1922, when it was first performed.

The recording, however, can be highly praised. The whole thing is a studio production, and its realism is good enough for a demonstration piece if you can find a bit where Dame Edith isn't giving you the creeps.

It is, nevertheless, an authoritative performance of Facade, and if you like it I can't imagine a better Christmas present.

TCHAIKOWSKY—Violin concerto in D major, played by Mischa Elman and the London Philharmonic Orchestra, conducted by Sir Adrian Boult. Decca LXTA2870.

I cannot raise much enthusiasm for this record. Mischa Elman wasn't a young man when I heard him in my youth, and the kindest thing I can say is that he plays like an elder statesman.

This isn't much of a concerto at the best, despite its lush moments, and requires an extremely brilliant hand at the helm. Elman never was brilliant. His smooth, dark tone is still evident, particularly in the middle movement, but elsewhere he is ponderous and uncertain. At all times he gives the impression of making heavy weather of it, and more than once is caught scratching.

The recording is fairly good, but this isn't enough to make the record worth high marks.

CHOPIN—Sonata No. 2 in B flat minor, Opus 35, Ballade in G minor Opus 23, Nocturne in F sharp minor Opus 15 No. 2.. LISZT—Au Bord D'Une Source, Hungarian Rhapsody No. 6 in D flat major. Played by Vladimir Horowitz. HMV OALP1087.

To me, Horowitz is a man who plays with his head and his hands —impeccably, dramatically and often

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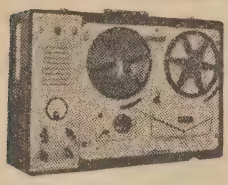

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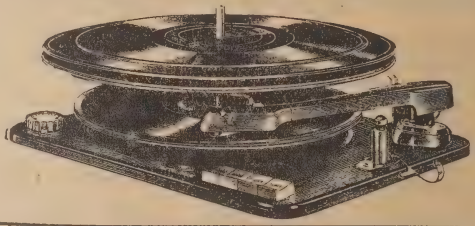

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beautifully, but I doubt whether there is a pianist who moves me less.

His pianistic command is incredible. There is just nothing he can't do, and its odds on before any selection is finished that he will do it.

Horowitz can no more avoid dramatics than he can stop breathing. I long to hear him play something, just once, simply and unadorned. I'o one with such an enormous control over dynamics, with such an easy and yet perfectly controlled change of pace, with such effortless technique, the flow of musical thought seems different from that of lesser men.

In Chopin, for instance, he shapes the melodic line as an essential framework to which ornament and elaboration are but secondary color —he collects them as he goes along, but he does not take us on a mental journey through them.

Maybe it all comes too easily to him, maybe his very perfection tends to discount what he is playing. Your reaction will be essentially a personal one—either you will think it magnificent or you will be disappointed.

The recording is distant, possibly for safety's sake, for Horowitz often plays with great power. The general tone is not bright, there is a slight tape hum, and even a suspicion of capstan wow. But the surface is very good and otherwise it plays quite cleanly.

DVORAK—Cello Concerto in B minor Opus 104, played by Pierre Fournier and the Vienna Philharmonic Orchestra conducted by Rafael Kubelik. Decca LXT2999.

This is a warm, glowing performance of a concerto which deserves to be better known. That it is not is probably because cellists who can handle such stuff are few and far between, and we rarely hear them in this country.

Without competition, I feel Decca's effort would be received with thanks, for there is much good in it.

But it has to stand comparison with one of the finest cello records ever issued—that of Janigro and the Vienna State Orchestra under Dean Dixon. To my ears it is rather like listening to the master and the pupil.

Janigro hasn't the same romantic approach of Fournier, and some might consider him rather too cool and aloof by comparison. But it isn't really so. Janigno's almost flawless playing has something of the Heifetz touch about it (as applied to the cello, of course), while Fournier rather "lays it on" a little too much for me. His tone, too, while warm and sympathetic, isn't the equal of his rival, either in its consistency or in the way it is produced.

I noticed some slight groove echo, too, on Fournier's performance.

There is evidence of over-control of microphone balance with Janigro, but this is one of the few criticisms I would make. Westminster's recording is superb, Decca's quite good effort is dull by comparison.

This sounds rather like a review of the wrong record, particularly as it is far too good to be summarily dismissed. But, to my ears, for all its virtues, it must take second place to Westminster's fine disc.

MOZART—Concerto No. 9 in E Flat Major—Concerto No. 15 in B Flat Major. Played by Wilhelm Kempf, piano, and the Stuttgart Chamber Orchestra with the wind of the Suisse Romande Orchestra conducted by Karl Munchinger. Decca LXTA2861.

There is an unhappy quality about this record, which prevents me from being over enthusiastic, although William Kempf gives a well-shaped and sensitive performance.

But the orchestra seems to have an uneasy ability to penetrate without achieving anything like a really good balance. It may be multiple mike job, but I had the impression that I had one ear close to the piano while the other was parked somewhere in the strings and woodwind.

Nor is the tone of the latter always as smooth, as it might have been. The piano, on the other hand, is quite good, although the whole performance is on the "small" side.

I'll leave you to judge this one. The surface is good.

TURINA—Canto a Sevilla, for soprano and orchestra. Played by the London Symphony Orchestra conducted by Anatole Fistoulari and sung by Victoria de los Angeles. HMV OALP1185.

Turina isn't very well known here. Noteworthy on records is the Sinfonia Sevillana recorded and released on 78's by the Sydney Symphony Orchestra a few years ago.

The same characteristic charm of that music is heard in this suite of seven parts. This work has the same simple and direct idiom—there are more than snatches common to both. Even on first hearing, it wouldn't be at all hard to place the composer.

Some of the sections include a part sung beautifully by Victoria de los Angeles, whose rich voice and smooth consistency fits the music like a glove.

The work is descriptive of the city of Seville, where Turina was born, and about which so much of his music is centred. It pivots around Holy Week in the city, but its programme, if it can be so called, is little more than a thread which holds it together. The general air is romantic, delicate and beautiful.

The recording is admirable in every respect. The voice, particularly, is a joy to hear—it is one of those records where the mechanics of recording melt away before gracious sound.

WAGNER—Dawn, and Siegfried's Rhine Journey; Siegfried's Funeral Music; played by the Vienna Philharmonic Orchestra. Brunnhilde's Immolation and Closing Scene sung by Kirsten Flagstad with the Philharmonia Orchestra. Conductor Wilhelm Furtwangler. HMV OALP1014.

There is little need to plug this record. In it we have both Furtwangler, who is now dead, and Flag-

stad, who has retired, in the kind of music they did best, coupled with two of the leading recording orchestras and some high grade recording.

It wouldn't matter much what other versions were or are obtainable, this one would not only be hard to beat, but has its own virtues which cannot be duplicated.

Furtwangler's intense dramatic imagination and his broad dynamic control are made to order for this music, possibly the highlights of the entire Ring cycle.

In it we will note Furtwangler's fine judgment of musical shape, and his ability to build a dramatic outline in which neither highlights nor shadows are ever saturated.

No matter how massive he builds the sound, there is still some in reserve even as the peaks are reached and recede. In my view this is Wagner of the highest order, no one can hear it without being moved.

Flagstad's contribution is on an equal plane, although there are spots where her voice shows signs of its decline.

The recording has emphasised the blending and weight of the orchestra, as is proper, but in the things that matter, the sonorous strings and eloquent brass, it is strong and effective. The slight surface rustle is quite lost behind it.

RACHMANINOFF — Concerto No. 2 in C Minor Opus 18. Preludes in G Major and G Minor. Played by Geza Anda, pianist, and the Philharmonia Orchestra, conducted by Alceo Galliera. Columbia 33OCX1143.

In its own way this recording is no more or less successful than several others we have heard in the past 18 months.

It scores over the recent Farnardi record mainly on the score of pace. Farnardi (or Scherchen) dragged interminably—the more so on a second hearing. The new disc is more like that of Moura Lympany, but the recording is very much better. It would probably share with Cor de Groot the first place in a not very hot field.

The truth is none of the versions to date are good enough to reach the top line.

Most of them try to make too much of the music, without allowing it to set its own pace. Others use a too forward piano, which ruins the whole conception of the concerto. Anda does all of these things, the impression being that he has not yet evolved consistently in what he is trying to do. As a result I tended to lose interest between his frequent spells of very nice playing. And for the most part the orchestra didn't impress me as being very interested either.

Some day, a really outstanding record of this concerto will be made, and will I welcome it!

The two preludes are as good as anything on the record.

Surface noise is enough to be noticed on soft passages.

BRAHMS — Symphony No. 3 in F major Opus 90. Played by the Philharmonic Symphony Orchestra of New York conducted by Bruno Walter. Philips ABR4031.

Most people take a full 12-inch disc to accommodate this symphony, but Bruno Walter does it on a 10-inch.

Some of the compression is probably due to careful micro-grading. But a good deal of it is the result of a pretty brisk pace which is held throughout, and which I'd say is on the verge of being too fast.

I'm not one for dragging things as a rule — I'd always like a little extra pace as against a drool, but this symphony I think gains by being unhurried.

There isn't any reason in the music or elsewhere to take it fast — this is music which stands to make its own pace, and which shows up a false tempo quite smartly.

Bruno Walter gave me the impression that he had an urgent date with the end of the record. Perhaps he had.

Something between this and Karl Bohm on his Decca release would have done me very nicely. Bohm's is good, but Walter has the firmer outlines.

The recording hasn't got nearly the open sound of the Decca, but of its type it is very good. The tone is round and the colors have an authentic glow. The surface is noiseless.

If it's not too fast for you, I'd say this is perhaps the bargain of the month.

WAGNER — Tannhauser Overture and Venusberg Music; Prelude and Liebestod from Tristan and Isolda. Played by the Philharmonia Orchestra conducted by Paul Kletski. Columbia 33OCX1129.

These long excerpts from Wagner can be frankly dreary and shapeless things unless tied together by a conductor whose sense of form and judgment of dynamics is impeccable, and who, in addition, has steeped himself in the story and mood of the music.

Obviously Kletski is one of the latter, for his performance, particularly of the Prelude and Liebestod, is to my mind near perfection.

There is a real emotional tug in his handling of the mounting tension, and authentic rapture in the impassioned climax. His sense of timing and his shaping of the musical line create a glowing surge of color which builds conviction into what is so often merely melodrama.

I thought this the most impressive side, although the excerpts from Tannhauser are of similar quality.

The Philharmonia is in first rate form.

This is really good Wagner, beautifully recorded, if you are looking for it.

HANDEL — Water Music (complete) played by the Boyd Neel Orchestra conducted by Boyd Neel. Decca LXT2988.

The Boyd Neel in my mind has always been associated with authentic and impeccable playing, and we have certainly heard enough from it in the past to justify this impression.

I was therefore surprised, and not pleasantly, to note a far from impeccable performance of the Water Music on this disc.

The recording itself has the finely etched outlines that Decca can give us, which expose with a merciless eye any fall from grace.

We can't miss, I am afraid, some sloppy and badly synchronised playing which occurs in the very first

sections of the suite and which don't noticeably improve as we go on. The horns have a prominent and vital part in this music, but the players here often disgrace themselves in a manner which even the unpractised ear will reject.

Nor has the playing the flexibility and grace the music demands. It has a school-masterish hand which doesn't sit at all easily.

No greater contrast could be imagined with the famous Harty records of earlier days from which so much of our listening standards flow.

I think we can do better than this.

OFFENBACH — Overtures, Orpheus in Hades; La Belle Helene. Played by the Los Angeles Philharmonic Orchestra conducted by Alfred Wallenstein. Festival-Decca CFR10-716.

A lively, clean, studio-type performance of two tuneful Offenbach overtures.

The studio is bright although without much echo. This tends to make the tone sound a bit shallow, particularly as the microphone placement isn't really close. The net effect, although by no means unpleasant, is what is often called "dry" as against the rounded sound of a bigger, more resonant chamber.

The frequency range isn't extreme, although the cymbals and so forth ring out impressively enough.

An attractive disc which should sound well on any instrument. A good surface.

VERDI—La Traviata. Opera for Orchestra, played by Andre Kostelanetz and his Orchestra. Philips N02108.

Operatic arrangements for orchestra are by no means a novelty but I don't remember having heard virtually a complete opera treated in this way before.

Assuming that you have no objections to the practice—and with an opera so filled with good tunes as Traviata I don't think you will—you'll enjoy this record.

It is played in quite a straight style—none of the tricks that go with many popular orchestrations of the day. Kostelanetz has made a serious attempt to keep the mood of each number strictly in sequence and in style.

The high pressure strings, particularly in representing the heart-broken Violetta in the last act, I found overpowering at times, but they certainly get the effect.

Some lovely cello playing, and recording, should be noted in Di Provenza, and in several other parts appropriately pitched.

The recording isn't wide range, but with such a silent surface I found the AES curve brightened it rather more than the EMI for which it was probably designed. The orchestra is forward and there is some very nice bass here and there.

Of its kind a good disc. An excellent Christmas present for someone who likes a good tune, and if it comes to that, don't we all?

GERSHWIN—Porgy and Bess. Tchaikowsky—Pique Dame, an Opera for Orchestra. Played by the Philharmonic Symphony Orchestra of New York conducted by Andre Kostelanetz. Philips N02111L.

My main impression of this record is that it makes a great deal of rich sound out of a background which has no scratch, no clicks, no hum, no nothing.

It has in addition a remarkably wide dynamic range, and this gives great force to the sudden dramatic changes which occur on both sides.

On both, too, there is plenty of free and vigorous scoring, sudden plunges of brass, upsurgings of strings and a mighty lot of weight when everything gets going at once.

It is this sense of restrained power about it which will undoubtedly impress you.

I thought the reverberation of the studio a bit more than desirable. This gives nice, airy sound, but it tends to make some of the instruments sound a "bit near the back".

The Porgy and Bess is a free and tuneful arrangement by Robert Russell Bennett, and naturally features all the main hits from the opera.

Pique Dame is a companion "Opera for Orchestra" to the Traviata record also reviewed here, and, if anything, it is even more successful.

It exploits the spectacular music with disarming frankness, introducing each mood with a capital letter, and making a very good fist of it.

Of its type, this record, like its predecessor, is in the top bracket. Once again the AES curve sounds best.

HANDEL—Arias and Choruses from the Messiah, with George Maran (tenor), Jennifer Vyvyan (soprano), Norma Proctor (contralto), and Owen Brannigan (bass), with the London Philharmonic Choir and Orchestra conducted by Sir Adrian Boult. Decca LXT2989.

Not everyone is in the market for a complete recording of the Messiah, although for my part I must admit that, with the quality of recordings now available, I find it much easier to listen to and enjoy a full performance (time permitting) than ever before.

It is filled with magnificent music.

As pointed out on the jacket of this disc, the Messiah lends itself to an abridged version much better than many other works. Consequently I find no difficulty at all in accepting the condensation represented by this release.

The excerpts are taken from Decca's full length recording, which was issued last year, and which is probably the finest of them all.

The soloists are all good. The chorus sounds rather restrained, and hasn't the full weight of a big choir of the type we generally hear in Australian performances.

But it certainly makes up in quality what it lacks in size. The truth probably is that today's heavyweights are less authentic than these more modest numbers, and Decca went to some trouble to reproduce the original intent on these records.

Best of all, there is no sign of distress or distortion such as so often overtakes recorded choirs, particularly when they sing all out.

At no time does this one reach full pressure.

In For Unto Us a Child is Born, we might miss the full emotional power of the cry. "Wonderful" as I have heard it done, but in quality, diction and every other requirement we gain by the restraint.

Printed and published by Associated Newspapers Ltd., at the registered office of the company, 60-70 Elizabeth Street, Sydney, NSW.

There is too much good work in his record to particularise—far beter to judge for yourself. Note paricularly the fine work of the harpsichord.

The surface is beautifully clean.

WALDTEUFEL — Waltzes Estudiantina, Espana, Golden Rain and The Skaters. Played by the Philadelphia Orchestra, conducted by Eugene Ormandy. Philips SO6612R.

There's little doubt about the appeal of these Waltzes. Waldteufel vas a contemporary of Strauss, and, ike the famous master, he wrote arge numbers of similar compositions.

In their own way, they are as uccessful and as well known as nany of Johann's, and are often acepted as being among those writen by him.

The recording is spacious, and, vith a remote touch which gives ather an effective ballroom atmoshere.

On the EMI curve it sounds a ittle dull, so I switched to AES vith good effect. This gave an extra ouch to the top.

Once again, no surface noise.

A particularly smooth, bright disc —a real Philadelphia production.

OUR NEXT ISSUE

OUR next big issue is due on sale, Friday, December 2.

Watch out for these features, which are now in the course of preparation:

- A detailed description of the audio mixing panel pictured elsewhere in this issue. The circuit can be followed in detail or readily adapted to meet a variety of requirements.
- More information on multiple loudspeaker systems, with emphasis on speakers of more modest design.
- A preliminary article by Reg Rawlings on the design of Vacuum-Tube Voltmeters. This will clear the way for the description of a companion instrument to our widely acclaimed audio generator.
- An "Argument" about electric organs. PLUS a variety of other features which are still in the Editorial "melting pot"!

Nixa continues to pile up its list f popular and special records, and me good ones have been received tely.

Volume A of "Jazz at the Philharonic" was, of course, made at an riginal performance, and features linois Jacquet, Hank Jones, Bill arris, drummer Jo Jones and others, l tied together in the atmosphere Carnegie Hall. It's a Clef original.

Another good Clef is supplied by x player Lester Young, who perrms the extraordinary feat, acording to Norman Granz' jacket te, of exhibiting a "coolness" with heat behind it. You can check is up by asking for MGC-124.

On MGC-120 Clef is Count Basie ith eight numbers, the first LP his latest recordings. And a Cook iginal comes eight by Lizzy Miles, ith Sam DeKemel with typically vid sound.

SHORT-WAVE NOTES BY ART CUSHEN

RAPID EXPANSION OF RADIO PAKISTAN

Though it has only been in operation seven short years, Radio Pakistan has made rapid strides and now broadcasts 96 program hours daily.

ESTABLISHED with the head offices at Broadcasting House 71 Garden Rd., Karachi, Radio Pakistan first commenced broadcasting on August 14 1947, and now has over 10-million home and many thousands of overseas listeners. Broadcasting House in Karachi was opened on July 16, 1951. The building contains 14 studios which are air conditioned, and eight booths embodying the latest sound equipment and studio devices.

SEVEN TRANSMITTERS

Radio Pakistan, a State monopoly, has now emerged as a compact and full-fledged national broadcasting organisation. Directors of External Services, Monitoring, Music, Research, Installation, and Maintenance, are located at Karachi, while news directors are at Lahore, Rawalpindi, Peshawar, and Dacca. A network of seven stations are located at Karachi, Lahore, Rawalpindi, Peshawar, Dacca, Rajshahi and Chittagong, on the broadcast band, and Karachi, Lahore and Dacca on short wave. The high powered Karachi station provides a national link with all zonal stations for broadcasts of national programs and centralised news in English, Urdu, Bengali, Pusheto, Baluchi and Kashmiri languages.

SHORT WAVE SERVICE

The high powered stations at Karachi also carry the voices of Pakistan to foreign countries, through seven external services, one each in Arabic, Afghan-Persian, Iranian, Burmese, and Gukrati. Two services in English are also presented, and the total duration of these broadcasts come to 4 hours 50 minutes each day. To this must be added the musical transmissions, which take a further 5 hours and broadcast to the United Kingdom, Turkey, Indonesia, South Asia and South East Asia. The linking of East and West Pakistan is made possible by a short wave link and a teleprinter service between Peshawar, Rawalpindi Lahore and Karachi. Six language publications are printed fortnightly in Urdu, English, and other local languages. Radio Pakistan now broadcasts some 96 hours each day as aginst 26 when first inaugurated. Pakistan operates two time zones, Eastern Pakistan (Dacca) is 4 hours behind Eastern Australian, and West Pakistan (Karachi) 5 hours behind.

The short wave transmitters have a combined power of 175 Kw, with the main transmitters at Karachi. Karachi—2 is 50 Kw, Karachi—3 50 Kw, Karachi—4 10 Kw, Lahore—2 1 Kw, Dacca—7 5 Kw.

TIME STATION CHU

REPORTED recently as being received by readers in Australia and New Zealand, our verification from CHU Dominion Observatory, Ottawa Canada, indicates that the station first commenced broadcasting on January 1, 1955, and as well as being heard in this area has also been heard in Europe and throughout North America.

CHU Ottawa broadcasts on the three observatory transmitters and are on the air continuously with broadcasts on 3330 Kc 300 W, 7335 Kc 3000 W and 14670 Kc 300 W. The transmitters use a three wired folded dipole antenna, on each frequency. The observatory point out that the transmitter frequencies are not to be considered as frequency standards. The musical pitch of 1000 cycles per second, which is characteristic of these signals, is derived from the transmitting quartz clock.

TIME ANNOUNCEMENTS

THE announcements which are given in speech each minute are obtained from either one of two machines constructed in France. The voice is produced from sound track cut from 35 mm film, mounted in grooves on a drum which is revolved at 30 rpm by a synchronous motor. The transmission consists of ticks, each one being 0.25 second duration and the beats are correct to better than 1000th of a second. The voice announcement is given between 50 and 59 seconds past each minute, and consists of the announcement of the time in Eastern Standard time, a 24hour clock being used, "Dominion Observatory, Canada, Easten Standard Time, —— hours —— minutes" is the type of announcement used.

The signal is relayed by stations of the Canadian Broadcasting Corporation over a network of over 60 stations, while the service is also used by telegraph stations.

The verification from Malcolm M. Thomson, of CHU, is two interesting pamphlets on the station, and he appreciates reports which are valuable to them to determine the range and usefulness of the CHU time signal. The return postage was returned by the station, and they hope that CHU will provide a service for listeners in this area in determining the correct time, which is so essential in the hobby.

WBOU REPLACES WNBC

AS we go to press we have heard a new call sign, WBOU, which appears to have replaced WNBC. Announcing on three frequencies, all of which were heard on different programs, the calls were given as "This is Voice of America station WBOU, Bound Brook, New Jersey, operated by the National Broadcasting Company, New York." Two transmitters have been heard from 4.30 a.m. to 8.45 a.m. on 15440 and 15150 Kc with broadcasts of the Armed Forces Radio and Television Service, New York, beamed to Europe. The other transmitter on 11870 Kc has the VOA broadcast in Russian from 7.15 to 7.45 a.m. and the same identification is used. Formerly W3XL and more recently WNBC, the signals have shown a marked power increase. WNBC and other short wave transmitters use a call sign which was formerly held by NBC key station in New York, which operates on 660 Kc. Some months ago this became WRCA and the shortwave station took the call of WNBC. As it is common practice for the four American networks to use the network letters in the call sign, such as WCBS, WABC, there is every possibility that shortwave station WNBC has also a new call sign.

FLASHES FROM EVERYWHERE

NAURU ISLAND the Australian Territory on the Equator is expected to commence operating a low powered broadcasting station in mid 1956. Like many others of the Pacific Islands a low frequency is expected to be used, and one in the vicinity of 2000 Kc will probably be the first to be given an experimental trial.

ROME'S 13 metre outlet, provides good signals on the band with a broadcast of English news at 8.40 pm, while previous sessions include Indonesian to 7.50 pm followed by French. The 16 metre transmitter on 17770 Kc also carries these broadcasts.

RADIO AUSTRALIA now broadcasts the DX session at 2.00 pm on 15200 Kc to North America, 3.30 pm on 17800 Kc to Africa, 6.44 pm on 17790 Kc to United Kingdom, and Europe South and South East Asia, on Sundays. The session at 2.15 am on Mondays on 7220 Kc, 11900 Kc to South and South East Asia and Europe.

KENYA'S Forces Broadcasting Service which has played such an important part for troop entertainment during the recent emergency, has commenced using two new frequencies, reports World Radio Handbook. Known as the Forces Broadcasting Service No. 2, and with the mailing address of Post Office 10, Nairobi, the station is at present operating as follows: 1.00-3.00 pm and 7.00 pm-6.00 am on 5034 Kc with 250 watts, while the same power is radiated on 6112 Kc, this transmitter being on the air from 2.00 pm-6.00 am.

PEIPING has introduced a second home program, and this is currently heard on short wave as follows, 7.00-8.00 am on 6790, 6810, 6890, 6997, 7370, 7485, 7770, 8.15-11.00 am on 9170, 9330, 9390, 9460, 11100, 11515, 11600, 12.50-4.00 pm on 11100, 11515, 11600, 15465, 15590, 15710, 15880, and 6.50-10.00 pm on the frequencies listed at 8.15 am, 10.10 midnight on 7370, 7485, 7770, 9170, 9330, 9390, 9460 Kc. The interval signal is played at the beginning of each period.

These notes are compiled by Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are Eastern Australian.

EGYPT'S overseas transmissions now embrace all continents, and the latest schedule shows the introduction of a service from Cairo to North America. The Egyptian State Radio is operating as follows, Arabic to Middle East, 1.45-5.00 pm on 7050 12030 Kc, 2.30-3.29 pm on 11670, 5.00-7.00 pm on 9795 (new frequency), 9.00-9.55 pm on 7050, 12030, 10.00-11.00 pm on 9795, 10.00 pm-2.28 am on 7050, 12030, 12.45-3.52 am on 9790, 3.00-6.59 am on 7050 and 12030 Kc, 4.00-8.00 am on 9790, 11670 Kc. Broadcasts in Hebrew, 2.45-3.00 am on 7050, 12030. Swahili, 2.45-3.30 am on 17765. South East Asia transmission is broadcast 9.30 pm-12.30 am on 17765 (this consists of Indonesian 9.30 pm, Arabic 10.30 pm, English 11.00 pm, Urdu 11.30 pm). To Western Asia, Persian 1.00-2.00 am on 9475, to Europe 4.00-8.00 am on 9475 (Italian 4.00 am, English 5.00 am, French 6.00 am), to South America 9.30-11.30 am on 11670 (Portuguese 9.30 am, Arabic 10.00 am, Spanish 11.00 am). To North America in Arabic only on 9790 Kc 10.00-11.00 am.

ITALIAN SOMALILAND which is seldom reported in this area these days is now using a more powerful transmitter, and broadcasts from Mogadiscio. The station uses 7072 Kc 300 W and 4978 Kc 4000 W daily as follows, Somali 7.30-8.00 pm, Italian 8.00-8.45 pm on 7072, 11.30 pm-1.00 am, 2.00-3.00 am in Somali, 3.00-4.00 am in Italian on 4978 and 7072 Kc.

THE HAM BANDS WITH BILL MOORE

A standard procedure has been inaugurated for the use of NSW radio amateurs operating in Emergency Nets. It should allow the most effective working of these nets and ensure the maximum benefit to the community in times of flood and bushfire.

THE Council of the NSW Division of the WIA have set up a series of rules for the guidance of radio amateurs during emergencies.

The rules lay down the standard procedure for operation in official WIA nets with VK2WI.

The first action of any amateur is to advise VK2WI (MU1092, MU1879) that an emergency is developing, and that he is about to, or has, offered his services as a member of the WIA Emergency Net to the district control officer of the State Emergency Services.

If no such officer has been appointed in the area, his services should be offered to the senior police officer.

Amateurs should advise the officer that the WIA net has been alerted and he is in a position to handle traffic to VK2WI in Sydney, or if in the Hunter Valley to VK2AWX official station of the Hunter Branch of the WIA.

Other stations in the affected area should report in to VK2WI for instructions in the event of being required to handle traffic in other nets such as to VK2AA official PMG station.

All messages from an emergency area must be authorised by the officer appointed by the State Emergency Controller or by the police officer in charge of the area. Service traffic handled will be authorised by the senior army, air force, or naval officer.

Amateur stations adjacent to the emergency area are requested to report to VK2WI in case their services are required.

Official VK2WI frequencies will be 3550 and 3575 kc/s and VK2AWX as arranged. These frequencies have been selected after careful checking with amateurs in all areas likely to be affected by floods to ensure no harmonics from c/c and other stations will cause serious interference.

Until a definite procedure for message handling is laid down by the combined services, Police Dept., and WIA &c. the Council recommends the adoption of the PMG's Department's Telegraph procedure.

VHF links are recommended for contacts between stations in any area. The division would also appreciate early requests for equipment and personnel if they are likely to be required.

It is anticipated that all amateurs will fully support the official WIA nets and so ensure that the movement will receive the maximum recognition for their work in these emergencies.

VHF ON LABOR DAY

The Labor Day holiday week, the first in October, is always a busy period for amateurs in NSW. Three major events were held over the week-end, The South-western Zone's Convention, the VHF Section's Spring 144 Mc Field Day and the Hunter Branch's Picnic held at Jackalls. These events are always well supported.

The weather was not very pleasant during the week-end and had serious repercussions on the VHF Section's 144 Mc Field Day.

High winds on Sunday October 2 reaching 60 mph hindered parties from reaching elevated spots and prevented some parties from venturing out.

The object of the event was to relay a message from VK2WI to Brisbane on 144 Mc/s.

A vital link in the north at Mt. Ebor was from Armidale was again manned by Roy Hart, VK2HO, and Perc Healy, VK2APQ, who journeyed from Sydney. They found it impossible to operate from the highest point due to the gale. Sheltered by trees they were able to work from inside the car at a position down from the peak.

Even then it was dubious how long the array would stay in one piece. The message reached them but could not be passed further north. Their only contact was with Peter Adams, VK2JX, at Wentworth Falls in the Blue Mountains, over a distance of 265 miles. Roy Berry VK2NY at Grafton some 75 miles away was heard at S9.

VK2ZAR journeyed to Sojala on the highlands over a terrific road but returned when the weather deteriorated. VK2AWZ was located at Mt. Tomah but also unable to man the highest point and transmissions were restricted.

The weather appeared to affect conditions and VK2WH of Forbes who operated all day only heard VK2ANF of Sydney for a short period.

Also in the field were VK2AZO and VK2ATO at Hassen Walls, VK2LG at the Gib, VK2HL at Razor Back and VK2ANU at Murrurundi. Other stations were active from their own QTH's. The total number of contacts made were small and paths normally covered were not open, the weather certainly affected the overall success of the day. VK2WI was manned by Bob Winch VK2OA for the field day.

WOY WOY TO COME

An extensive program has been arranged for the NSW Division's Annual Woy Woy Field Day and those attending are assured of an interesting day.

Attendances since the event's inauguration have always exceeded 200 and this year's event should be well supported.

Assembly point is at the Masonic Hall, Woy Woy, the date November 27, and registration will commence at 10.30 am.

The morning session comprising competitions will commence at 11 am and an all-band scramble will be conducted from 11.45 to 12.30. The lunch break will be from 1 to 2 pm. At 2 pm searchers will leave on the 144 Mc/s hidden transmitter search. The transmitter will operate until 3.15 pm. Special events will be conducted from 2 pm for the ladies and the juniors.

The general reunion and prize presentation will be held from 4 to 5 pm.

Make Woy Woy the location for your Sunday outing, the field day is an excellent opportunity to show your wife the social side of amateur radio, there will be dozens of prizes for all attending.

NEXT WORLD CONFERENCE

It appears that the next full scale International Telecommunications Conference will probably take place at Geneva in 1957, when frequency allocations throughout the radio spectrum will again be reviewed.

Prior to this meeting in August 1956, th CCIR Technical Convention will be held at Warsaw. Amateur Radio Societies in Region 1 (Europe and Africa) have decided to hold an International Amateur Radio Union Region 1 Conference in Italy early in 1956.

It is hoped at this meeting to discuss all aspects of amateur radio organisation and to obtain ideas of effective action to be taken at the forthcoming international conferences. The question of direct amateur radio representation at both these international conferences will be discussed as it is considered by the RSGB that such action is desirable as proved when RSGB delegates represented amateurs at the 1947 Atlantic City ITU conference.

The activities of the Region 1 Bureau of the IARU are financed from contributions from all national societies in the region and excellent liaison is kept between all the varied amateur movements.

The Italian Society (ARI) have offered to act as hosts, the selected venue Como, and it is anticipated that many European and African societies will be represented to plan for the future of amateur radio.

UHF IN THE WEST

The last meeting of the VHF group was held at the residence of Don VK6ZAV. The usual large gathering was present. The growth of the group has been remarkable in the six months of its existence. Very soon we will have to hire a hall to accommodate the numbers.

Frank VK6CC gave an interesting lecture about the effect of moisture on receiving equipment illustrating his talk with his experiences in the tropics and in eastern States.

The remarkable improvement in the sensitivity of AR8 receivers from 10 microvolts to less than 1 microvolt by merely heating the receiver in an oven was a graphic illustration of how much loss can result from a humid atmosphere.

The November meeting of the group is to take the form of our first fox hunt. Those without mobile gear should make a determined attempt to assemble some sort of receiver and antenna for the event.

The following are believed to be the VHF records in the West:

50 Mc/s: VK6HK/VR2CG, date 3/1/55, distance 3928 miles.

144 Mc/s: VK6BO/VK5GL, 31/12/51, VK6BO/VK5GL, 9/2/52, and VK6BO/VK5QR 9/2/52, all over a distance of 1328 miles. The world record is 1400 miles.

288 Mc/s: VK6BQ/P to VK6DW/P, 1949, 25 miles.

Any claims for recognition for greater distances should be made to Stan Stewart, VK6ZAS, 95 Railway Pde., Mt. Lawley, WA.

The above notes were contributed by Wally Howse, VK6ZAA.

ROSS HULL CONTEST

It is intended to extend the frequency range of operation in this year's Ross A. Hull Memorial Trophy Contest in accordance with the previous decision at a previous Federal Convention of the WIA. To date the contest covered the 50 Mc band only. It is anticipated the contest will now include the 50, 56, 144 and 288 Mc/s bands. VHF amateurs here are divided on the extension of the range of the contest in view of experience gained since the convention decision.

Seventy-eight members and visitors attended the September general meeting of the NSW division of the WIA when Mr. E. Stern, of the Civil Aviation Department lectured on the Instrument Landing System in use at Mascot. The lecture was enjoyed by those attending as evidenced during a 30 minute question time.

Considerable discussion was also centred around the future plans for the setting up of a permanent HQ for the division and the possibility of establishing of VK2WI at a point distant from the city.

This would allow effective transmissions to be carried out with higher power on the lower HF bands.

SOUTH-WEST CONVENTION

The South-Western Zone's Convention held at Albury was extremely successful and some 70 amateur XYL's and YL's were in attendance. Visitors from Sydney, Melbourne, Bendigo, Cobram and Wollongong were in evidence.

The convention was officially opened by the Mayor of Albury Ald. C. E. Bunton OBE, who welcomed the visitors to Albury. He was introduced by the chairman zone officer Jim Edge VK2AJO. Jim Corbin MBE, VK2YC, president of the NSW division responded on behalf of the members of the WIA.

A full program was arranged varying from a visit to the Hume Weir, an official dinner, field events, musical quiz, pick-a-box, &c.

THE VK-ZL CONTEST

Radio amateurs enjoyed this year's VK/ZL DX contest run jointly by the WIA and NZART. Support for the contest was greatest for some time. Opening to the world on 21, 14 and 7 Mc/s reflected the great improvement in propagation conditions and some excellent scores will undoubtedly be recorded.

Morning conditions were interrupted on 7 Mc by extensive Russian amateur station activity. As noted last year it appears that the Russians run a contest on the same week-end as the VK/ZL test. DX contests should again become popular as it is possible even with restricted operation to contact a host of stations.

The contest was conducted by the Federal Contest Committee currently located in South Australia and logs for the contest should be forwarded to reach the committee Box 1234K, GPO, Adelaide not later than October 31.

Commercial QRM on the exclusive amateur sector 7000 to 71000 Kc/s is undoubtedly on the increase but the effort of BAB/BAB2/BAB3/ Chinese Press station on 14 Mc/s is worth recording. In a long list of frequencies on which they operate they include 14140 Kc/s and they surely cause serious interference.

DX CONTEST

The WAE DX contest conducted in late September was well supported and afforded stations located in Europe an opportunity to work with stations in the other continents. It ran for two 48 hour periods, one for CW one for telephony. The regular openings now appearing to Europe gave VK stations many contacts on both 7 and 14 Mc/s over long periods.

The control of this contest is varied annually and rotated between the various national amateur radio societies in Europe.

This years contest was organised by the German National Society the DARC.

The RSGB Bulletin carries further news of proposed amateur radio activity on the Gough Island Scientific Expedition. ZD9AD should be in operation in mid-October. The equipment to be used by G3HPM includes a Panda 120V Transmitter, an Eddystone 680X receiver, six 45gt sectional masts, 3000ft of various types of feeders and sufficient wire for a variety of antennas.

Operation will be on all bands covered by the transmitter including 1.7 Mc/s.

Likely emphasis will be on the 21 Mc/s band using both CW and telephony. It is hoped that the ARRL will recognise Gough Island as a separate country.

ZD9AD will not reply to calls within 10 Kc/s of his own frequency and stations who call when he is in contact with another station will be black-listed. QSL cards have already been printed and will be forwarded via the RSGB.

QSL Bureau incoming cards should be sent the same way.

It is anticipated the expedition will remain on the island for a period of six months.

Amateurs in the US have officially been co-opted to attend atomic tests at Yucca Flat. The NEC of the ARRL, emergency co-ordinator George Hart, W1NJM, was requested to attend. Although no amateur frequencies were used during the tests, a considerable number of amateurs were included in the Government emergency exercise group which was responsible for the communications of the test.

A.O.C.P. CLASS

The Victorian Division A.O.C.P. Class will commence on Thursday, November 17, 1955.

Morse and Regulations are held on Monday and Theory on Thursday evenings from 8 to 10 p.m. Persons desirous of being enrolled should communicate with **the Secretary, W.I.A., Victorian Division, 191 Queen St., Melbourne.**

Phone FJ6997 (from 10 a.m. to 4 p.m.), or the Class Manager on either of the above evenings.

VHF NEWS FROM N.S.W. DIVISION

The attendance of the October meeting of the NSW Division's VHF section reached an all time high when Mr. R. Mondel of the NSW Technical Education Department recently returned from America lectured on TV and TVI. In a comprehensive review Mr. Mondel covered all aspects of TVI including many little known sources and told of his actual experiences in these matters. It was a lecture of considerable importance to members and gave a further insight into possible problems ahead.

Visitors to the meeting included well known country VHF amateurs Keith Dodd, VK2ZAA, of Tumut and Stewart Savage. VK2PL, of Griffith.

The section will conduct their initial 144 Mc communication tests on October 16 with the Spelaological Society at Jenolan Caves and will check the value of radio as opposed to telephone contact in the society's work.

At the conclusion of the NSW Division's VHF section's Sunday evening broadcast over VK2WI a surprise 144 Mc scramble was announced. Commencing immediately at the conclusion of the broadcast it ran until 10 pm, approximately 2½ hours. The winner of the event was Peter Adams, VK2JX, with 24 contacts, second place was filled by VK2ZAR, VK2LG, and VK2APQ all with 22 contacts and third VK2HE with 21 contacts.

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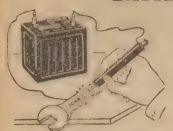

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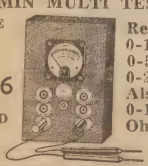

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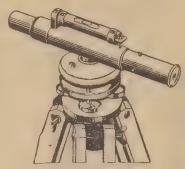

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Not a toy. A real Microscope. Hours of enjoyment for any boy or girl Student.

3 Turrets
3 Magnifications.

£4/19/6

100, 200 and 300 times magnification

BINOCULARS, BRAND NEW. VERY POWERFUL.

Complete in solid pig-skin leather case.

£7/15/-

Fitted with High Class Ground Lenses.

BRAND NEW LEVER TYPE GREASE GUNS WORTH £4/19/6

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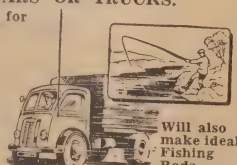
Ideal for all types of Trucks, Tractors or Cars, 7500lb pressure.

STEEL ARMY TANK AERIAL RODS WILL MAKE IDEAL RADIO AERIALS FOR CARS OR TRUCKS.

Too long for postage. Advise nearest railway station. Bases to suit Aerials, 12/6 each.

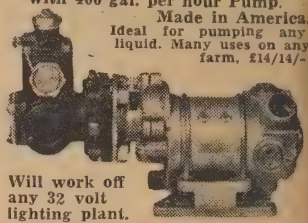


Will also make ideal Fishing Rods.

12ft long, 3 sections. Each section 4ft, 22/6, 8ft long, 2 sections, 15/-.

Aircraft 24 volts Motor complete with 400 gal. per hour Pump. Made in America.

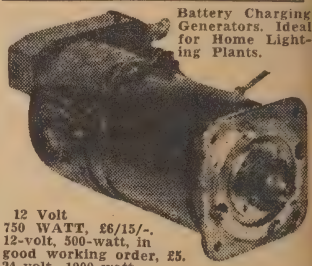
Ideal for pumping any liquid. Many uses on any farm, £14/14/-



Will work off any 32 volt lighting plant.

Pump only, 55/-.

Battery Charging Generators. Ideal for Home Lighting Plants.



12 Volt 750 WATT, £6/15/-.
12-volt, 500-watt, in good working order, £5.
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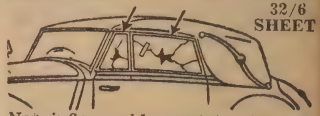
200 amp Generator. Ideal for welding. Made in America. Brand new £40

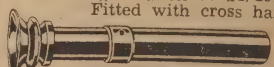
Replace those broken side curtains with cellulose acetate which takes the place of celluloid and lasts four times longer. Will not discolor.

32/6 SHEET



Non-inflammable acetate sheet is recommended for all types of side curtains. Sheets are 20 thousandths of 1 inch thick. Size of sheet, 24in x 52in. Can be sewn or cemented into frames.

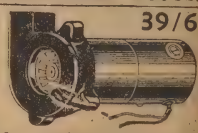
ARMY FOCUSING TELESCOPE
Easily converted for use on dumpy levels. Can be used as a rifle sight. Excellent magnification . . **£4/19/6**
Fitted with cross hair.



ADJUSTABLE FOCUS.

English Motor and Blower, 24 volts.
Will work off any Lighting Plant.

39/6



Large size also available that will work off 12 or 24 volts, £3/15/-.

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rom Victoria Street. Phone FJ5904.

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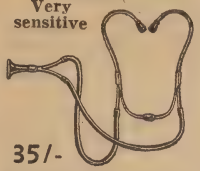
Include State in Address.

MECHANICS' STETHOSCOPES
Ideal for Testing Engines, etc.
Very sensitive



35/-

SPECIAL DISPOSALS METER OFFER

0-3 amp meters, AC-DC, 2½in dial 45/-
0/1 milliamp, 2½in dial .. 37/6
Weston 0-50 volt 0-100 amps. combined M/coil, £3/10/-

nglish 50-0-50 Ammeters, M/coil 37/6
nglish 0-50 Ammeters, AC-DC .. 42/-
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nglish 0-300 AC-DC Voltmeters .. 55/-
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nglish 0-40 Ammeters, 2½in dial, AC-DC 42/-
nglish 0-30 Ammeters, 2½in dial, AC-DC 45/-
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ng. 0-200 Ammeter, M/coil .. £4/10/-
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ng. 0-30 Amps AC-DC 2½in dial .. 42/-
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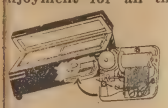
ng. 0-1 Amps DC 2½in dial .. 35/-
ng. 200 Amps AC-DC 3½in .. £4/19/6
ng. 0-5 Amps AC-DC 2½in .. 45/-

low you can make your own music ox with these Swiss music units. hey can be fitted to any type of box, oil, jug, teddy bears, etc. Hours of njoyment for all the family.



30/-
EACH

unes available, Lili Marlene, Jingle ells, Blue Danube, Harry Lime heme, Wedding March, The Merry Vidow, Happy Birthday, Annie Laurie, ow Dry We Are, Roll Out The Barrel, ilent Night, Teddy Bears' Picnic. lso available, a few only double units hich play 2 tunes, 50/- each. liniature Music Units fit cigarette case, ady's Compact, etc. 39/6, also 230 volt lusic Unit, works continuously, 59/6.

Not secondhand.
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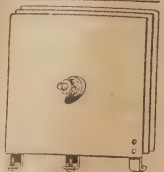

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2v 2 amp .. 32/6
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ransformers to suit above Rectifiers. amps, 39/6; 6 volt, 5 amps, 45/-; 12 volt, amps, 55/-.

Brand New American Wobble Pump, semi-rotary

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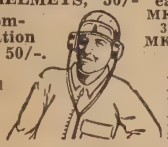

MK7 Goggles 37/6 Pair.
MK8 Goggles 48/6.

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WOOL LINED FLYING BOOTS. £5/19/6 pr.

HUGE PURCHASE
Waterproof Flying Suits.
Special Price £4/7/6.

Dalton Computors in good working order, 50/-.

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TELESCOPES

Latest Model, complete with Tripod

Achromatic Coated Lens. **£9/15/-**
Ideal for Rifle Shooters.
25 Magnifications.

At last the spotlight you have been waiting for.

Fitted with genuine American sealed beam globes. No motorist or boat owner should be without one.
6 Volt, 90/-; 12 Volt, 95/-.
Complete with Switch and Flex.

Ideal for Fox or Rabbit Shooting

COMPLETE BATTERY CHARGER

Fitted with Brand New English Selenium Rectifier.

Works off 230v. Household Supply.

Charges any battery, 6 volts at 4 amps, £6/15/- complete. Also available, 6 or 12 volt Charger combined. Charges 4 amps, £7/15/-. Brand new 6 volt, 3 amp Chargers, complete, £5/15/-.

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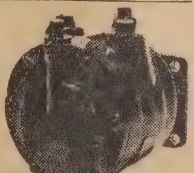

Builds up air pressure to 20lb at 1000 R.P.M. develops up to 120lb of hydraulic pressure; will pump 7½ gallons S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems, £3/10/-.

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IDEAL FOR SHOOTING FIT ONE TO YOUR CAR.

6-volt, 37/6
12-volt, 25/-
Fitted with Mirror Reflector.

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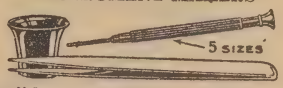


English Tweezers .. .. .. 6/6 and 5/6
Eyeglasses .. .. 6/6 and 8/6
Extra strong double lens Eyeglasses 15/-
Screwdrivers, set of five 13/9

SPECIAL OFFERS FROM OUR MOTOR ACCESSORY DEPARTMENT

American Shrader tyre pumps, work from your spark plugs, 39/6. Car type fire extinguisher. Every car should carry one. Cost £7/10/-, £4/10/-. Mechanics' steel tool boxes, 19/6. Brand new 7/8in spark plugs, suit most old type cars, 2/6, or ideal for tractors. S.A.E. or Whit. Spanner Sets, open one end, ringed the other. 6 spanners to set, 23/6. Army steel tow ropes, looped ends, 17/6. S.A.E. open end spanners, 6 to set, 24/6. Whitworth, 4 to set, 18/6. Whit socket sets, 13/6 set. Mudguard type rear view mirror, 16/6. Inside car rear view mirrors, 4/11. S.A.E. socket sets, 15/-. Engineer's pliers, 4/6. Car jacks, 37/6. Tyre levers, 3/10 each. Hydraulic 2-ton jacks, £4/15/-. 6-volt windscreen wipers, £4/12/6. 12-volt £4/19/6. Car pumps, 14/-. Shifting Spanners 4in 6/9; 6in 8/-; 8in 10/-; 10in, 11/-; 12in, 18/6. Metric Socket Set, complete with bar, 59/6. Feeler Gauges, 4/6. Tail Lights, 5/9; 12in Steel Rulers, 3/6, 6in, 2/6. Set of 3 Screwdrivers, 2/6. Hydrometers, 11/6. Piston Ring Compressors, 15/-. Pressure Oil Cans 9/6. Combination Pliers, 5/6. Car Amp Meters, 15/6. 4½in saw blades complete with arbor, ideal for making saw bench with electric drill, 25/-. Bell-ringing generators, ideal for telephones, 25/-. German Army marching compasses, work similar to prismatic, 32/6. 110 volt 1000 watt projector globes, 32/6. ¼in Black and Decker 230 volt electric drills, £11/15/-. ½in, £24/8/3. Magnifying Glasses, 8 mags., 8/6. 10 magnifications, 12/6. 24 volt motor and hydraulic pump, capacity 3½ gals. per minute, £3/15/-. New headphones suitable for crystal sets. 17/6 pair. Army Mosquito Nets, ideal camping, 27/6. Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, 39/6. 230 volts input 5 amps at above voltages also available 45/- each. Brand new American Cutting and Welding Torches £4/4/- complete. Army Slouch Hats in good order, 19/6. Generator Test Meters, 35-0-35 amp meters, 4½in dial, 45/-. 0-10 volt meters, 4½in dial, 45/-. Loading Resistors can be supplied to make meter read 10.20 at 12/6. Medical Scalpels, many uses, photographers, etc., 6/6.

A COURSE IN TELEVISION

(Continued from Page 95)

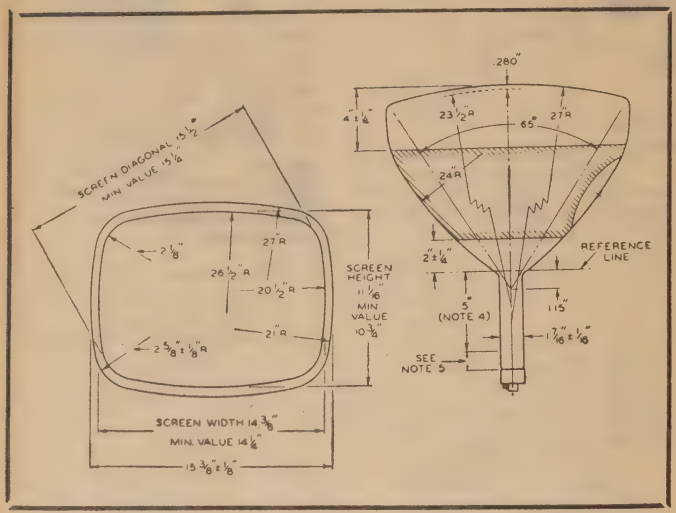


Figure 22: This diagram gives the essential dimensions of the 17BP4-A picture tube (or "kinescope"). It is one of the types scheduled for local production. Prototypes have already been assembled and demonstrated.

or a wholly electromagnetic controlled beam, it would be possible to combine the principles so that a particular tube may have electrostatic focus and electromagnetic deflection—or even the reverse! This is purely a matter of tube design.

To date, practically all television picture tubes have used magnetic deflection. The main reason for this is that the magnetic system is capable of deflecting the beam through much greater angles without loss of focus. As a result, picture tubes can be made with large screens without, at the same time, being prohibitively long.

Magnetic focusing has commonly been used, more or less to be consistent with magnetic deflection. A great deal of development has gone into focus and deflection coils and modern types using ferrous cores are far more efficient than the earlier open style windings.

We shall have more to say about these items in a later article.

OVERSEAS TREND

In the meantime, there is an evident trend overseas toward tubes employing electrostatic focus and electromagnetic deflection. Special proportioning of the electrodes makes the focus so non-critical that the need for a focus control has been eliminated altogether. The various anodes are simply connected to a predetermined divider network across the EHT supply.

It seems doubtful at the moment whether such tubes will go into immediate use in this country, the present intention of manufacturers being to standardise on conventional magnetic-focus and deflection tubes with a 17in rectangular screen.

This measurement, by the way, is an overall diagonal one, corresponding to the diameter of a round-face tube necessary to produce the same-sized image. Dimensions of a typical "17in" picture tube, the 17BP4-A, are shown in figure 22. As a matter of interest, the weight of this tube is about 25lb.

Such conventional 17in tubes are available overseas in a variety of brands and are scheduled for production in local valve factories under the appropriate type numbers.

HIGH VOLTAGES

In service, these tubes typically require an EHT (Extra High Tension) supply of between 14,000 and 18,000 volts.

As might be imagined, the generation, distribution and control of such voltages call for considerable care in receiver design, not to mention the safety factor in relation to those who have to build, service and operate the equipment.

Even apart from the problem of high voltages, large screen tubes have to be very carefully constructed to withstand air pressure on the envelope.

The total pressure on the screen of a large picture tube can be reckoned in tons and an undetected flaw in the glass could easily cause it to collapse. The resulting "implosion" could hurl fragments of metal and glass over considerable distances and cause severe injury to anyone in the vicinity.

In any case, large picture tubes must always be handled carefully, to avoid jarring or scratching.

Various applications of cathode ray tubes have led to the development of screen materials having a variety of color and persistence characteristics.

By way of example, American CR tubes carry a phosphor number associated with their type designation.

To quote the most popular ones, "P-1" indicates a green, medium-persistence screen, especially suited for use in a cathode ray oscillograph. "P-5" is a blue screen with very short persistence; while "P-11" is of similar color, but simply designated "short persistence". "P-7" is a cascade phosphor showing an initial blue color, which fades to a greenish-yellow, long-persistence trace.

Most cathode-ray tubes intended for television receivers use the "P-4" screen, which gives a nominally white trace and exhibits a medium persistence characteristic.

COLOR OF IMAGE

In many cases, the trace is actually bluish-white in color. It is claimed that a bluish-white image is less tiring on the eyes, particularly if noise and interference is present along with the vision signal.

Some picture tubes, and in particular the larger types, have an "aluminised" screen, the normal fluorescent coating being backed up by a layer of very finely divided aluminium particles. These particles provide a partial mirror which reflects forward light which would otherwise be wasted inside the tube.

A notable increase in picture brightness is claimed, particularly in larger tubes where the electron beam has to "illuminate" a much larger screen area.

Tinting of the glass is also employed in some tubes, or tinting of the safety glass in front of the tube face. Purpose of this is to minimise the reflection from the tube face of ambient room lighting. The picture brightness is also reduced, but the ratio of picture to reflected light is improved, because the reflected light has to pass twice through the tinting, the picture only once.

One other interesting point should be mentioned by way of conclusion. In most modern picture tubes, the electron gun assembly does not point directly at the centre of the screen, as indicated in figures 18 and 20. Instead, the gun assembly is bent so that the cathode-grid structure points obliquely toward the neck of the tube.

Purpose of this modification is to protect the screen from damage by heavy ionised atoms which may be accelerated toward it along with the electron stream.

NEGATIVE IONS

These negative ions are formed when low speed electrons attach themselves to atoms of residual gas. They are not readily influenced by the magnetic deflection fields and, if not diverted in some way, would simply strike and "burn" the centre of the fluorescent screen.

By offsetting the gun at a slight angle, the ions are directed toward the side of the tube and never reach the screen. A small magnet is sufficient to deflect the electrons, however, back into their correct path.

Examination of the gun structures in figure 21 will show their bent construction quite clearly.

(To Be Continued)

LET'S BUY AN ARGUMENT

(Continued from Page 99)

fairly accurate description of the esults he was getting.

We duly explained that the cor- ect procedure was to switch his ilter to the "wide open" position nd simply use his tone control to chieve the most pleasing overall alance. If certain records, particu- arly the older 78's, sounded dis- orted and harsh, then he was to set is filter for as low a cut-off fre- uency as necessary, only retarding is tone control if further restric- ion of the treble seemed desirable.

It was simply a matter of appreci- ting how the controls were to be sed—one to achieve a suitable bal- nce on pre-emphasised records and he other as a purely emergency neasure to combat distortion and oise.

In discussing this point, I may be oing N.F.G. an injustice. He may now as much about it as I do. But nen again he may not. In any case, hat I have said may serve to put omebody else on the right track.

By way of conclusion, a few re- harks may be appropriate about ransistor sets, in particular those e described earlier this year.

Right from the start, we were most areful to point out that the designs ere purely exploratory and in- ended to familiarise our readers ith transistor principles. We ointed out that they had very little F gain as such, that regeneration ould not be relied upon and that ey were only suitable for use in reas of high signal level—good uburban locations, &c.

CLASS-B SET

Then came the description of the lass-B output job for which we laimed an output of about 370 illiwatts. This was no exaggera- on and, whenever we have switch- d the set on since, feeding into a rge speaker, we've had to re- ssure ourselves that all that noise as really coming from a 9-volt ias battery via a couple of tran- stors.

It sounds really loud.

BUT we also mentioned that the ain was lower than the earlier lass-A job, that a modest outdoor erial was necessary and an earth ire was essential. In other words ou couldn't get a lot of sound out ithout feeding a lot of signal in.

Despite such statements, several eaders have been enthused by the lea of building a transistorised car adio, using the class-B circuit.

The letter reproduced earlier under e heading "Transistor Set" is quite pical.

When will people learn the dif- erence between power output and ain?

To be sure, the class-B transistor set can make a lot of noise but only when it is fed with a large enough signal. Only when it is connected, as we said, to a reasonable outdoor aerial and an earth and used in a good location.

If the length of aerial is reduced a few feet, as in a car, and if its ight is reduced to an average of out 3ft from the "earthy" car dy, instead of at least 15ft above ground, the signal it can pick up becomes very small indeed.

So, if the set doesn't have a lot of gain—and no simple transistor set has—then it lacks the ability to amplify the weak signals to the re- quired degree. Far from the output being just a "bit weak", it would actually be nil.

Contrariwise, a set having a lot of gain can amplify weak signals to a useable level even though, in the ultimate, it may not be able to drive the loudspeaker quite as hard.

Transistor sets will not become a good all-round proposition for home- builders until it is feasible to achieve both high gain and adequate power output—economically, of course.

When this day arrives, they will really be an attractive proposition for car sets for they will operate straight from the car's electrical system, without need for a vibrator supply and all its attendant worries. They will draw so little current that drain on the battery will not be sig- nificant.

But that day hasn't arrived—yet!

Two Months Clearance Sale

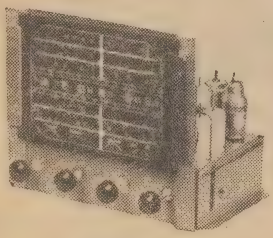
OF LARGE QUANTITY OF DISPOSAL RADIO AND ELECTRICAL EQUIPMENT

FOUR PAGES OF BARGAINS AVAILABLE DURING OCTOBER AND NOVEMBER ONLY

IF WHAT YOU REQUIRE IS NOT ADVERTISED WRITE ENCLOSING SELF ADDRESSED ENVELOPE FOR SPECIAL SALE QUOTE

NEW RADIOGRAM - CHASSIS KIT - SETS

5 VALVE DUAL-WAVE



Complete kit of parts including 12in Magnavox or Jensen Speaker, five valves (1 6SA7, 1 6K7, 1 6SQ7, 1 6V6 and 1 6X5) and all other parts to the last nut and bolt to complete the five valve dual wave chassis illustrated.

These chassis when completed give excellent overseas, local and interstate reception as the coils supplied and intermediate transformers are high gain Permatune iron cored. Pick-up switch and volume control with A.C. switch supplied. Suitable for use with any crystal or high impedance magnetic pick-up.

LIST PRICE OF PARTS £25 __SPECIAL PRICE £12/17/6

WIRED-AND-TESTED £2 EXTRA

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METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS N.S.W. PHONE LA6087

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NEW SPEAKERS BY LEADING MANUFACTURER

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Available with 10T or 7T Transformer.

POSTAGE & PACKING EXTRA: N.S.W. 4/6 — INTERSTATE 5/6.

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NEW VIBRATOR POWER-SUPPLY

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12mfd 525 V **3/9**
500mfd 12 V **2/-**
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(Plus Postage)

12-inch P.M. SPEAKERS

Heavy duty 12in per-mag speaker by well-known manufacturer. 10T. CT. or 5,000 Transformer. **NOW 45/-**
Postage: NSW, 5/6; Interstate, 7/6.

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These New Vernier Dials are ideal for test equipment, receivers, etc.
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1,500 ohm Field coil,
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9in x 6in. 1,000 ohm
Field, 5,000 or 7,000 ohm
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Eight pin loctal sockets moulded
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Color-Code
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Well-known make of carbon resistors in values of 100 ohms to 5 megohm. In 1-watt, ½-watt and 1/3-watt. All resistors are standard color coded and in original cartons. In lots of 100 mixed values comprising 50 1-watt, 25 ½-watt 25 1/3-watt.
Price: Box of 100 .. .. **7/6**
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Power Transformers

New midget power trans. Upright mounting with cover plates. 240v. Pri. Sec. 225 x 225 at 50 Mill. and 6.3V at 3AMP. **17/6**
Plus postage 2/6 NSW, 3/9 interstate.

60 mill. upright mounting 240v. Primary, sec. 265 x 265 at 60 mill. 6.3 and 6.3 volt filiment windings. **22/-**
Postage: N.S.W. 3/6; Interstate, 5/6.

I.F. TRANSFORMERS

Standard I.F. transformers, square can. (1⅜) 455K.C., permatuned. **3/9** each.
Plus Postage

CONDENSER SPECIAL

Boxes of 100 new mica and paper condensers in values ranging from 50pf. mica to .5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1 etc.
25/- PER 100
Plus postage.

TELEPHONE GENERATORS

New small telephone generators, ideal for bell ringing etc.
8/6
Postage extra.

I.R.C. RESISTORS

100 I.R.C. carbon resistors, ½, 1 & 2 watt. in values 50 ohm to 5 meg. including many popular sizes, 3T, 15T, 20T, 25T, 50T, 100T, 250T, 500T, etc.
(Standard resistor color code supplied.)
Box of 100 **16/6**
(Plus 1/6 postage.)

NEW VIBRATORS

6 volt A.W.A. gas-filled vibrators. Heavy duty synchronous **NOW 7/6 or 70/- per doz.**
2V. Synchronous vibrators **12/6**
A.W.A. standard six pin synchronous vibrators, in original cartons, 12 volts. Half price.
12/6
Plus postage.

NEW IT4 BATTERY VALVE
10/- ea.

PICK-UP CARTRIDGES

Rothermel high fidelity pick-up cartridge. Replacement for most pick-ups. **6/6 ea.**
ACOS Cartridges 7/6

SAPPHIRE NEEDLES

Rothermel sapphire needles play 2000 recordings. Made in England. Each 2/9 or 25/- dozen.

POTENTIOMETERS

Standard ½ or 1 meg. switch pots long spindle d/p switch.
5/6
½ meg. or 25T. ohms short spindle switch pots **2/6**
½ meg. or 100T. standard pots. long spindle. **3/-**
½ meg. or 100T. short spindle.
1/6
All plus postage.

Please address all correspondence to 479 Parramatta Rd., Leichhardt, N.S.W.

METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, N.S.W.
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, N.S.W. PHONE LM3610

£7/15/- F.O.R.

NEW AMERICAN INDICATOR-UNIT

These indicator-units contain the following valves:

Six 6SN7GT, one 6G6, one 6H6, one 6X5GT, one 2X2, and 3BPI C.R.O. tube which is fitted in a separate shield on a 4ft shielded lead and supplied with control box and plug; case and shield are finished in black brocade. In original cartons.

TRANSFORMER TO CONVERT THIS UNIT FOR 240 VOLT OPERATION AVAILABLE AT £3/-/- EXTRA, plus postage.

MIDGET GENEMOTOR

Input 28 to 32v at 1.1 amp. Output 250v. at 60mA. New in carton.
£2/-/-
Used but in good order.
£1/10/-
Postage extra.

Input filter supplied with genemotors

28-volt GENEMOTOR

Input 28 to 32v. Output 250v at 65mA. Used but AS NEW
£1/-/-
POSTAGE EXTRA
NSW 5/-, Interstate 11/-

American Radar Transmitter Type ASB

CONTAINS
Two U.H.F. Triodes Type 15 E
Four Sets of Lecher Bars.
Transformers, ceramic mountings, Motor Blower, etc. Also High Voltage Vacuum Change-Over Relay. Nominal Frequency 515 m/cs. Ideal for conversion to U.H.F. Channels, Variable Coaxial Cable and Link Matching Lines. Contained in Aluminium Case.

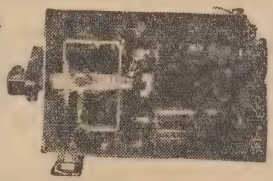
Dimensions 18in x 7in x 8in. **£2/-/-** F.O.R.

A.C. AMP METERS

A.C. Amp Meters (ex-Country Council). A necessity in any electrical workshop.
RANGE. 0-5 amps. (can be extended by shunts).
MOVEMENT. 300 degrees.
SCALE LENGTH. Nearly 15 inches.
DIAMETER. 7½ inches. **25/-**

Postage extra — N.S.W., 6/6 — Interstate, 11/6.

H.F. OSCILLATOR

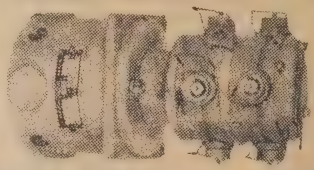


Frequency approx. 200 m/c Adaptable to the 144 m/c Band. Complete with 2-7193 Valves. and two pair Pye Co-ax Connectors.
Type "B" 12/6
POST FREE

FULLAPHONES

Containing pair of headphones, morese key, buzze key switches etc.
Post N.S.W. 6/6 interstate 8/6. **15/-**

6SH7 VALVES—TESTED 3/



22/6
PLUS POSTAGE

AMERICAN ANTENNA SWITCHING MOTORS

Complete with 8 Pye-Type Co-ax Bases, R.P.M. 1750, Ball Bearing, 24 Volt.

PLUGS AND SOCKETS

New 26-pin shielded plugs and sockets with silver-plated contacts.
5/- pair, plus postage
5-pin shielded plugs and sockets **2/9**

TRICKLE-CHARGER KITS

Kits for trickle-charger as described in R. & H., June issue Comprising transformer with 18V winding tapped at 12V-3 100mA rectifiers and 50 ohms control.
Postage: NSW, 5/- Interstate, 7/6 **32/6**

NEW AMERICAN WALKIE-TALKIE CHASSIS

Type SCR-536 less valves, case, crystal. **£3/17/6**
Valves used 2.354, 1.1T4, 1.1S5, 1.1R5, postage extra.

NEW METERS

English 3in turner, flush mounting. 10MA movement _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ **20/-**
English 0-600v with shunt, 3in flush _ _ _ **20/-**

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METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, NSW.
PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, NSW. PHONE LM3610

NEW AMERICAN TELEPHONE WIRE CLEARANCE

Rubber-insulated with stainless steel and copper conductors supplied on metal reels each containing half a mile of wire.

½-mile reels NOW 15/- Post Extra

In case lots—6 reels (3 miles) NOW £4/0/0

RADIO ALTMETERS, TRANSMITTER RECEIVER TYPE RT-3A/ARNI.
Complete with the following valves:—5-12H7, 2-12H6, 2-12SJ7, 2-995, 2-9004 and one VR150. Midget 28V. Genemotor. _ _ _ _ _ _ _ _ _ _ _ _ _ **£4/17/6** f.o.r.

AIRCRAFT BOMB SIGHTS

These sights contain 4in spirit filled compass with corrector. two spirit levels, rack and pinion and many useful gears. The unit is mounted in wooden case with locks and handle.

£1/17/6 F.O.R.

TELEPHONE RELAY PANELS

These panels contain 50 volt 100MA Rectifier, sensitive relay bezel with lamp and holder, phone jacks, etc.

8/6
Plus 5/- postage

NEW VALVES

807 _ _	12/6	12SR7 _ _	2/6
7C7 _ _	3/6	12SQ7 _ _	2/6
7C5 _ _	5/6	IT4 _ _	10/-
6K7G _ _	7/6	KT61/6U7	7/6
6V6G _ _	12/6	1K5	2/-

All Plus Postage

OIL-FILLED CONDENSERS

20mfd. tapped	600V.	15/-	
15mfd.	600V.	10/-	
4mfd.	600V.	5/6	
3mfd.	2000V.	15/-	
1mfd.	400V.	2/9	

All Plus Postage

RELAY-TYPE COUNTERS

("Mercury" American Made) These relay counters register from 0 to 99,999. Can be supplied with 250ohm, or 5,000ohm coils.

22/6
plus postage

P.M.G. TYPE RELAY-COUNTER

0—9.999.
1,300 ohm coil **15/-**

TELESCOPIC AERIAL

These new all-brass 108 aerials measure 13 inches and extend to 5ft 3 inches in five sections .. . **12/6**
Bakelite mounting base for above **3/6**
Plus Postage 3/6.

BUTTERFLY CONDENSERS
Capacitance range 3-35 microfarad. Size 1¼ x 2¾ x 2¼ inches. Brass plates: Ultra high frequency installation; ¼ inch shaft
Price each **8/6**
Packing and postage, NSW, 1/-; Q., T, and V., 1/6; WA, NT, 2/-.

24-VOLT MIDGET MOTORS SHUNT WOUND

Fully Laminated Fields, Wound Armature. Sixteen Segment Commutator, ball-bearing Armature. Ideal for Model Trains, Hobbyists, etc. Condition New.
Price, each **32/6**
Packing and postage: NSW 1/6; Interstate 2/6.

Transformer and metal rectifier to operate either of above. From 240V AC 30/- Plus postage.

NEW FLEXIBLE DRIVES

Flexible drives to suit command transmitters or receivers 5ft 6in long. **12/6** Plus postage.
To suit compass receivers 2ft long. **10/6** Plus postage.

HEAVY DUTY GENERATOR

Suitable for conversion to A.C. motor (approx one-sixth H.P.) Fully laminated. Can be used as 6 or 12 volt generator at 20 or 13 amps. **£2/10/-** f.o.r.

Please address all correspondence to 479 Parramatta Rd., Leichhardt, N.S.W.

METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, N.S.W.
PHONE LA6087

479 PARRAMATTA ROAD, LEICHHARDT, N.S.W.
PHONE LM3610

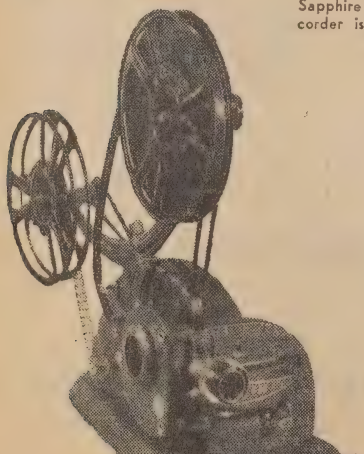
SAPPHIRE! *Australia's lowest-priced two-speed Tape Recorder*

Now available for low deposit

When you twist the neat playback dial on the Sapphire Hi-Fi Tape Recorder, you'll be amazed to hear that business conference, kiddies' party, choir or orchestra, come back to you with startling reality. Designed for superb playing and recording wherever there's a power-point, the Sapphire Hi-Fi tape Recorder is ideal for all recording purposes. The many precision-built features include: Two speeds (3¾in and 7½in per sec.). Three motors. Independent base and treble controls for playback. Electro-dynamic take-up and braking. Amplifier output is (1) 3 watts undistorted; (2) 5 watts with 10% total harmonic distortion.

Weighing only 31 lbs., the Sapphire Hi-Fi Tape Recorder is **£112 or £12 deposit**

Pathe movie equipment



The "Pathescope" GEM 9.5 mm. Projector

This ideal projector provides: variable speed control, use of 900ft reels; independent light switch; 1¼in lens in combination with optical system gives a 6ft screen at 20ft; built-in transformer; sturdy lamp for 50 hours' screening. All revolving parts self-lubricating. Price £54/10/-, £13/10/ deposit.

The Pathe 'National'

Designed for the advanced worker the "National" features an F.1.9 coated Som Berthiot focusing lens (half meter to infinity), built in optical view-finder with masking for four lenses and parallax correction down to one meter; can take single pictures. Is capable of speeds from 8 to 32 frames per second, fully swing-open gate and has 30ft daylight charger loading.

£58/19/6, £14/19/6 deposit.

The Pathe Model 'H' Camer

This camera is ideally suited to th needs of the amateur who desire first class results. Finished i black crackle enamel, the Mod 'H" is supplied with an F2.5 20 mm fixed focus superior quality lens t an interchangeable mount. It ca take single pictures or continuou running has footage counter and tripod bush.

£33/5/- or £8/5/- deposit.

A second four speed model "H camera (10, 16, 24 and 32 frame per second) is also available fo £36/10/- or £9/10/- deposit.

BOYLANS

14a OXFORD STREET, SYDNEY
FA8787, 2 doors from Winns.

ANSWERS TO CORRESPONDENTS

D.H. (Ormond, Vic.) asks us if it would possible to add a 6M5 output valve the Super Three circuit described in e June, 1952, issue of the magazine.

A: The main point of the Super Three as to be able to build a receiver which ve good results with only three valves. his was accomplished by the use of one uble valve to act as audio amplifier d output stage. If you wish to build receiver having more than three valves would be better to use one of the more andard receiver circuits.

Typical circuit is the Little General for 51 described in the July, 1951, issue of e magazine which uses the valve types AN7, 6N8, 6M5 and 6X4.

J.V.Z. (Nudley, Qld.) asks if it is posble to solder aluminium to aluminium to other metals.

A: From time to time various solders become available through hardware ores which are claimed to be able to do is. We have not had the opportunity use these to determine how good they although we have private doubts on e matter. Of course there are ultrasonic ldering irons which use high frequencies to break down the oxide which readily forms and makes the soldering aluminium so difficult. For further formation on these we would refer you Mullard Australia Pty. Ltd., 35-43 larence St., Sydney, NSW.

H.B. (Windale, NSW) asks us to inform im of the manufacturers of the Regency transistor receiver described in a cent Technical Review.

A.: We regret H.B. that the only inormation that we have available is that is in current production in the USA. s far as we know, there are no local gents or distributors.

P.R. (North Balwyn, Vic.) writes to tell s that he used a .5 and a .25 resistor in eries for the feedback resistor in the ecord player described in the Feb, 1949 sue instead of the .75 resistor specified. hen he shorts the junction of the two esistors to earth the volume of the mplifier increases.

A.: This is because in shorting out this esistor you short out the negative feedack from the output valve to the first alve. Whilst the gain increases so can ie distortion be expected to increase, ecause of the removal of this feedback. owever, if you prefer to use the amplier in this condition, there is no special eason why you should not do so.

E.B. (Waiourie, NZ) writes and asks us we can advise him on the capacitance the gang used in the shortwave Conerter in the July 1955 issue of the magane as he is unable to obtain the AWA pe given in the parts list.

A.: The gang used was a standard iniature broadcast gang and any similar pe gang which is obtainable on your cal market would be satisfactory. Howver we suggest that you get in touch ith the AWA representative in New ealand and see if supplies are available.

C.R.C. (Cobden, NZ) says that he has dapted our crystal set (Aug. 1954) as a ner for his amplifier. He says that the eneral performance is very good.

A.: There is certainly something to be id for the idea in a good locality. The gh gain of a modern amplifier often lows the crystal set to operate with a inimum of aerial and detector coupling, ereby making the best of selectivity. e are glad to note that you like the rgument" series.

C.E.S. (Barcaldine, Qld.) writes to the viceman in support of F.J.C. who sugsted that the serviceman should publish gular assessments of commercial radio ceivers, whether such remarks are commentary or not.

A.: Many thanks for your letter and mment, C.E.S., and we will pass these to the serviceman for his possible nment. It must be realised, of course, at there is far more to it than a mere blication of one's opinion. Derogatory marks may be hard to "prove" if they re ever challenged in a court of law.

B.B. (Ravenshoe, Q.) writes to request details of all the seven and nine-pin valve types together with their electrical characteristics, substitutes, and equivalents in the octal range. He also asks for information on the use of ultraviolet lamps in the search for minerals and the type of power supply required. A further request is for information on the making of an electric fence.

A.: Well, B.B., we suggest that for valve information you could not do better than consult the various valve companies who will be better able to assist you in this matter. It would not be possible for us to print all the available information in the magazine, as it would just about fill a complete edition. From the same source you should be able to obtain information on the ultraviolet lamps. With regard to the electric fence information, this is obtainable through the normal two-shilling query service and will be sent on request.

T.B. (no address) comments on an audio amplifier design.

A.: Many thanks for your letter of the 18th ultimo and for your comments about audio amplifier design. They are logical material for use in the "Argument" columns and, space permitting, we will discuss them at length in a forthcoming issue.

E.W. (Dubbo, NSW) renews his subscription to R, T and H and says he is getting excellent results from his "1952 Advance" receiver.

A.: Thanks for your letter and the enclosed subscription. We are pleased to note that your set is performing well and that you find "Off The Record" so helpful. It is to be hoped that your "Playmaster" gear will materialise soon. We agree that the motor is a problem and a high-priced unit appears inevitable if the best results are to be assured. The set-up you are planning should be capable of excellent results.

G.W.L. (Christchurch, New Zealand) asks for further information on the Induction Stethophone mentioned in the News and Views in the July issue of the magazine.

A.: We had several requests for further information on this unit and accordingly published a more complete article in the October issue which should be of interest to you.

A.P.T. (Montmorency, Vic.) has observed that the first figure of American valve type numbers bears a relation to the filament voltage but is confused over the use of "1" as a prefix of such 2-volt valves as the 1M5, &c.

A.: Yes, A.P.T., it does appear a little confusing at first and, in fact, there are many who believe that the ideal valve numbering system is yet to be evolved. In the case you mention confusion arises over the need to differentiate between 2-volt and 2.5-volt types. The system provides that all voltages up to and including two shall be designated by the figure "1" and values above this but below three by the figure 2.

R.M.M. (St. Kilda, Vic.) has read our transistor articles with a good deal of interest. He wants to know how their power output compares with a portable battery set.

A.: We are glad to note that you liked the articles, particularly the one on class-B. The gain of the class-B set is not very high but on a strong station it can make a good deal more noise than the average battery portable. We have never tried transistors in push-pull parallel but they could probably be made to work in a class-B circuit. Drive might be a problem, however. Class-A operation might be more critical, since the bias requirements of the individual transistors may not be close enough to give optimum conditions for all units simultaneously. Higher powered transistors are already on the way.

A.H.G. (Bexley, NSW) has built the Basic crystal set of March, 1951, and has obtained good results from it until the recent increase in power, which is causing severe interference. He wants to know what can be done to improve matters.

A.: Reducing the length of the aerial or tapping it farther toward the earth end of the coil should help, though only at the expense of signal strength. At the same time you may still be better off than before the increase if an optimum setting can be found. Alternatively, we suggest the Twin Tune Crystal Set of April, 1951, since this permits the coupling between two tuned circuits to be adjusted for optimum selectivity and sensitivity. Copies of this circuit are available through the normal query service.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

How Good are our Amplifiers?

(Continued from Page 89)

performance, which should be achieved by a high-quality amplifier.

OUTPUT: Not less than 10 watts for any kind of listening, 15 watts for loud listening, and 30 watts for very loud listening.

FREQUENCY RESPONSE: Level between 35 cycles and 30 Kc, and, if possible, to over 100 Kc. In any case flat to plus or minus 1 db up to the final roll-off, which should occur at a regular rate not greater than 6 db per octave.

DISTORTION: Not more than 1 pc THD at full output nor more than .25 pc at say half-power point. Not more than 1.5 pc IM at full ouput or more than .5 pc at half-power.

TRANSIENT RESPONSE: No more than 10 pc of overshoot on 5KC square wave with 2-3 microsecond rise time. Ringing should be much lower in amplitude and damped completely within 50 pc of the flat top or less. More work is needed to clarify the importance of this test.

POWER CURVE: Flat between 50 cycles and 10 Kc. Not more than 10 pc down at 25 cycles and 15 Kc.

STABILITY: No sign of oscillation at full output on sine waves, or square waves at 5 Kc with speaker load. (Full output tests on speaker load are rather impracticable.)

NEGATIVE FEEDBACK: The main loop should include the output transformer and be not less than 15 db, or more than 20 db unless all other requirements are met. With triode or U-L circuits this should ensure adequate speaker damping. With U-L circuits there is already a feedback loop around the output circuit approximately equal to 6 db.

LINEARITY: Should show no variations up to overload. Triodes or U-L connection should ensure this.

Any amplifier which can meet these requirements must be considered in the superlative class, and it should be virtually impossible to tell one from the other no matter how much these figures were improved upon. Even amplifiers, which fall short of some requirements, may still lay claim to extremely high quality.

We have built so many Playmasters using such a wide variety of output transformers that it is impossible to list them in any order of excellence. But any of the triode or U-L types using the very best transformers available should meet these requirements.

Some of the curves shown here illustrate this point in some degree. The 17-watt job we considered the best all-round amplifier we have had.

On the other hand, commercial types tested from time to time would not meet some of the essential points. One of them is also represented in the curves with this article. It would be quite unfair to mention names, and we will not do so, for even this amplifier sounded good on a comparative listening test.

ACTUAL TESTS

Intermodulation tests with the Playmaster show that distortion is less than 1 pc up to maximum output, and below .5 pc for most of the power range. At 1 watt it was virtually immeasurable.

Quite recently, with the co-operation of a friendly broadcasting station in Sydney, we had a check made of the harmonic distortion of this amplifier, as it was after about eight months continuous use with the original valves and components. No adjustments of any kind were made to it prior to the test.

Distortion figures were so low that the overall distortion of the measuring equipment at times was greater than that of the amplifier. This made final estimated figures difficult to obtain and somewhat unreliable, as instrument distortion does not add and subtract arithmetically as we were forced to do.

However, for what they are worth the THD figures showed .075 pc at 1 Kc and 1 watt, .12 pc at 5 watts and .2 pc at 15 watts.

At 50 cycles and 10 watts, distortion was .15 pc, and at 7.5 Kc and 10 watts it was .15 pc.

A check on the amplifier before testing would almost certainly have reduced distortion still further, and would have provided a better comparison with commercial amplifiers. Obviously, however, it is so low as to be negligible right up to full output.

OTHER FIGURES

Incidentally, the amplifier gave 20 watts at 1 Kc with 6 pc distortion. Its hum and noise figure was particularly good at 76 db below 1 watt, or a VU figure of about -46.

The sum total of all this discussion seems to be that we do not yet know enough about the absolute requirements of a maximum fidelity amplifier, certainly not enough to lay down absolute specifications, all of which are founded on an accurate basis. There is a rich and fascinating field of investigation wide open for someone to explore.

We can, however, say without hesitation that, using the best components available today, the Playmaster series of amplifiers is at least as good as any commercial counterparts, and in our experience is generally better.

Whether differences are detectable by ear, when comparing amplifiers of this class, is another matter. We must use our own judgment until such time as we can relate the comparison to reliable standards.

FROM THE SERVICEMAN WHO TELLS

(Continued from Page 43)

ime the rubber holder was pushed n far enough to be securely held here was a grave risk of shorts to he metal channel.

With all these hazards, replacing he dial lamps in a manner which vould ensure reasonable freedom rom shorts was quite a ticklish job.

Truth to tell I am a little ahead f myself at this point. To be quite ccurate I should have interrupted ny description of the dial lamp prob- ems soon after I started it, because t was then that the "strange noises" uddenly appeared.

The noises were indeed strange, ven by servicing standards. It was cross between a whispering and a inging effect, with just enough of he latter to suggest microphony at ome point.

This was confirmed by tapping, vhich aggravated the condition, and t was eventually traced to the icinity of, and then directly to, the CK32 converter. Replacing it with a ood one cured the trouble and everal changeovers confirmed that t really was the valve.

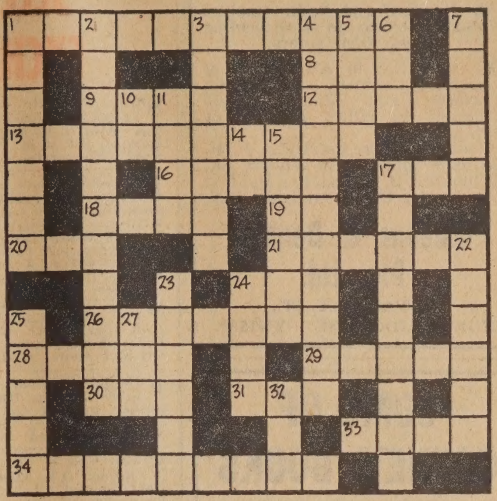
This done I reverted to the dial amp installation as already des- ribed. Then a general once over, n alignment check, and the set was eady for its owner.

Summing up these two jobs one oint is immediately obvious: several f the faults should never have hap- ened. Firstly, while no one expects dial cord to last forever, it is ertain that it will last longer if he mechanism it is to drive is easy o move; either because it is mech- nically well designed or because t is not gummed up with congealed grease.

Again, the instability (after the hield had been repaired) should ever have occurred, being an bvious case of poor design.

The over-greased volume control annot, of course, be blamed on the et manufacturer.

THE R. & H. CROSSWORD No. 19



ACROSS

1. Number of cycles per second (pl.).
2. Short sleep.
9. Send out.
12. Meeting by appointment.
13. With wavelengths of less than 20cms.
16. Device for measuring an interval.
17. Atmosphere.
18. Used for book binding.
19. Credit (abbrev.).
20. In time past.
21. Adjusting a resonant frequency.
24. Higher range of audio frequencies.
26. Special milk preparation.
28. Metric unit of length.
29. Boy's name.
30. Electrical Engineer's Numerology (abbrev.).
31. Finish.
33. Girl's name.
34. Variable resistor (pl.).

DOWN

1. A set form.
2. Electrolytic conductor.
3. To wreathe round.
4. — continuous waves.
5. Organs of hearing.
6. Conveys information secretly.
7. Part of an electric motor.
10. Mister (abbrev.).
11. A jot.
14. Amplitude Modulation (abbrev.).
15. Straight line depicting magnitude and direction.
17. Adjustment of receivers.
22. Harnessed.
23. Deputies.
24. Melody.
25. Color.
27. A mined substance.
32. Complementary to a bolt.

Solution and further crossword next month

Building a 5-valve Clock Radio

(Continued from Page 73)

n the layout, the additional wiring hould not present any problems. In act, apart from the filament line, ll the connections can be made with he pigtails of the components. On he other hand, although we have escribed the changes in some detail, he layout is not particularly critical. Ve merely laid it out that way be- ause it seems to be the easiest and nost logical way to do it.

ALIGNMENT

The finished set will need to be ligned in the usual way, preferably sing a modulated oscillator and out- ut meter. However, if these are not vailable, a good job can be done sing the broadcast stations as a ource of signal. If you are not amiliar with either of these align- nent procedures, we can supply a amphlet giving the process in de- ail. It is available through our ostal query service, price 1/-.

In any case it is essential to rea- ise that the proper performance of the set cannot be expected until this has been done. If necessary, seek the assistance of your local serviceman or someone who has the necessary equipment and experience.

The only points peculiar to this set concern the trimmers, oscillator slug, and ferrite rod aerial. The trimmers and oscillator slug, by reason of their position and the need to adjust them in conjunction with the dial setting, must be adjusted after the set is mounted in the cabinet. Holes should be provided in the bottom of the cabinet to allow this to be done.

The ferrite rod aerial is adjusted at the low frequency end of the band exactly as in the case of a slug in the aerial coil. The adjustment is made quite simply by moving the winding along the rod until a position of maximum output is obtained. This will be quite sharp and, once it is found, the winding should be fastened in this position in a positive manner.

That done, you should have a receiver which will be hard to beat for sensitivity and all-round performance, plus the convenience of the clock mechanism and a truly handsome cabinet.

Last Month's Solution

E	L	E	C	T	R	O	S	T	A	T	I	C
L		A			I	R	E		T			O
E	A	R	S		S	P	E	C	T	R	U	M
C		T	H	R	E	E	P	O	L	E		M
T	A	H	O	E		N		M	E	T		U
R	A	T	E	S				B	E	R	E	T
O	R	E		I		L		S		O		A
L		R	A	S	T	E	R		W	A	T	T
Y		M		T		A			C			O
S	P	I	R	A	L	S		M	E	T	E	R
I	O	N		N		T	E	E		I		S
S	T	A	R	C	H		V	A	L	V	E	
		L		E		W	E	T		E		

WANTED TO BUY, SELL OR EXCHANGE

SELL: Complete set of Modern Test Equipment, new condition, guaranteed O.K. Also Hi-Fi Amp; Ham gear; Tubes. Send for list. **B. M. Plowman, 78 Murdoch Road, Wangaratta, Vic.**

FOR SALE: Back issues of R. and H., every copy available. Ex-stock, good stocks late issues 4/- per copy, incl. post. Write for information on circuits, etc., in back issues—designs for all types of radio gear—test equipment, etc., etc. **T. Weir, 73 Gibson Avenue, Padstow, N.S.W. UY8056. Prompt Service.**

SELL: Garrard 201B 3-speed transcription motor, unused, ½ price £15; Rola 120X speaker, RJ cabinet, £6/10/-; R. & H. wide-band tuner, new, £5. **Colson, Oriental Hotel, Mudgee, N.S.W.**

FOR SALE: Four 5BP1 Cathode Ray tubes and one 1500 volt power transformer to suit C.R.O. All new and original packages, £10. **W. Johnson, 152 North East Road Walkerville, S.A.**

SELL: A. & R. Ultralinear output transformer O.T. 921-8 20W 6,6004-8,2, £7. New, unused. **L. Jenkins, 557 Malvern Road, Toorak, Vic.**

SELL: 5 new 826 Tubes, £1 each. **B. Glassop, 343 Kissing Point Rd., Dundas**

SELL: Thorens CBA 83 hardly used and perfect, £38. Type 3 MK 11 T.R.PS. Two Xtals £20, two each tz40, 866JR, 807, one 813 with SKT, £9 **F. Leybourne, 6NA, Narrogin, W.A.**

SELL: MN—26C compass set, 150-1500 K/cs, 28 volt, new with plan, TR1196A, 3—9 K/cs, 12 volt, unused. Kit to make 4½in reflect. telescope. Offers wanted. **188 Gilles Street, Adelaide, S.A.**

WANTED: Radio Service Manual Vol. 9 in good order. Write to **A. Ginter, 16 Chrysler Rd., Croydon, S.A.**

SELL: Technical Booksellers, **56 Hunter St.,** Sydney. For radio Television Books. Write for lists.

SELL: Printing, Special Offer:—100 Business or Visit Cards, 30/-; 100 Letterheads, 30/-; 200 £2. Sent anywhere by mail. Do it now! **W. Hiley, 841 George St., Sydney.**

FOR SALE: R. and H., Jan., 1950-Jan., '55, complete except for Aug., Sept., '52. New condition. Offer. **Smith, 76 Bellbird Avenue, Norlane, Vic.**

SELL: Printing Machine and Accessories, new condition, good supply type, ink. Worth £150, sell £85, rail anywhere free, can make good money with this. **Hallett, Jeweller, Roma, Queensland.**

SELL: Complete new radio servicing outfit, including University's Supertester Supertracer, Oscillator, together with over 100 new modern valves, large quantity new components, total cost £280 wholesale a few months ago. Sell the lot for £150. **Bidgood, 139 Avoca Rd., Avoca Beach, via Gosford. Phone 5.**

FOR SALE: UHF Portable Aerial System. FJ2219. 3 Marville Av., Kingsford, Sydney.

Pen Friends—Everywhere!

Interested in swapping ideas with pen friends in Australia and many other lands? Write for full free information on this fascinating hobby. Send name, age and address to:

UNIVERSAL PEN CLUB, Dept. 2, Box 5189, G.P.O., Sydney.

ANSWERS TO CORRESPONDENTS

J.E.P. (Toorak, Vic.) would like to know if we have published circuits and articles dealing with photographic timers. He also sends in a circuit for one, and mentions one approach, in which the heating up time of a valve is utilised for timing.

A. Several circuits for photographic timers have been published in this magazine, J.E.P., and you will find them in our June, 1949, and January, 1952, issues. Copies of these circuits are also available through our query service. The circuit you have sent in should also work, as far as we can see at a glance. However, the idea of using the heating time of a valve would be quite unsuitable for such applications. As you say in your letter, it would be far too inaccurate to have any practical value.

W.T. (Ravenshoe, Q) asks us if a licence is required to operate a Walkie-Talkie and if we can supply any circuits of such equipment.

A.: It is not possible to operate any transmitting equipment without a licence and a Walkie-Talkie is no exception. As regards circuits we described a 144 Mc Handy Talkie in the Oct. 1950 issue of the magazine and copies of this are obtainable through our two shilling query service.

R. G. (Bexley, NSW) writes to ask us to explain the theory of the vacuum voltmeter.

A.: As this question would call for too long an answer for these columns and as the question is one of general interest we suggest that you watch the "Answer Tom" section of the magazine. We may be able to give the answer that you require.